

# Design and Manufacturing of Welding Fixture for Fuel tank Mounting Bracket

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**Abstract**— Fixtures, the component or assembly that holds a part undergoing machining, must be designed to fit the shape of that part and the type of machining being done. The parts to be welded are placed in proper position in fixture and tightened. Welding fixture holds and supports the work piece, prevents distortion in work piece during welding process and withstands high welding stresses. This paper gives detailed information about designing and manufacturing of welding fixture for fuel tank mounting bracket assembly. It contains various tilting and rotating arrangement which makes it versatile during its use. The material used for the fixture is mild steel which is capable of withstanding the load. CO<sub>2</sub> welding is used for the welding the parts of the bracket. It also contains number of locating pins which makes it accurate at the time of working. The coordinate or geometry off these pin position are measured with the help of coordinate measuring machine (CMM).

**Keywords**— Design, manufacturing, welding fixture, CMM.

## 1. INTRODUCTION

A fixture is a device for locating, holding and supporting a work piece during a manufacturing operation. Fixtures are essential elements of production processes as they are required in most of the automated manufacturing, inspection, and assembly operations. Fixtures must correctly locate a work piece in a given orientation with respect to a cutting tool or measuring device, or with respect to another component, as for instance in assembly or welding. Such location must be invariant in the sense that the devices must clamp and secure the work piece in that location for the particular processing Operation. Fixtures are normally designed for a definite operation to process a specific work piece and are designed and manufactured individually.

The correct relationship and alignment between the components to be assembled must be maintained in the welding fixture. To do this, a fixture is designed and built to hold, support and locate work piece to ensure that each component is joined within the specified limits. A fixture should be securely and rigidly clamp the component against the rest pads and locator upon which the work is done.

Fixtures vary in design from relatively simple tools to expensive, complicated devices. Fixtures also help to simplify metalworking operations performed on special equipments. Fixtures play an important role on reducing production cycle time and ensuring production quality, by proper locating and balanced clamping methods .Therefore to reduce production cost, fixture design, fabrication and its testing is critical.

Welding is a metal joining process by heating of the materials to a suitable temperature with or without the application of pressure, or by the application of pressure alone, with or without the use of filler metal. Welding is one of the most common processes in the manufacturing industries. The purpose of a welding fixture is to hold the parts to be welded in the proper relationship both before and after welding. Welding fixture will maintain the proper part relationship during welding. The process of fixture designing and manufacturing is considered complex process that requires the knowledge of various areas, such as geometry, tolerances, dimensions, procedures and manufacturing processes. Good fixture design will, of itself, largely determine the product reliability.

Welding fixture is the most common device used to align and retain the various pieces for welding.

### 1.1 Various element of fixture.

Generally, the entire fixture consists of the following elements.

**Locators:** A locator is usually a fixed component of a fixture. It is used to establish and maintain the position of a part in the fixture by constraining the movement of the part.

**Clamps:** A clamp is a force actuating mechanism of a fixture. The forces exerted by the clamps hold a part securely in the fixture against all other external forces.

**Fixture Body:** Fixture body, or tool body, is the major structural element of a fixture. It maintains the relationship between the fixture elements namely Locator, clamps, supports, and the machine tool on which the part is to be processed.

**Supports:** A support is a fixed or adjustable element of a fixture. When severe part displacement is expected under the action of imposed clamping and processing. Welding fixtures for work piece comprise the usual locating and clamping elements as used in other fixtures. However, the effect of heat and prevalence of welding spatter must be taken into account while designing hot joining fixtures.

### 1.2 Design of welding fixture.

Fixture components may be built into various arrangements to accommodate different workpieces. Fixtures must always be designed with economics in mind; the purpose of these devices is to reduce costs, and so they must be designed in such a way that the cost reduction outweighs the cost of implementing the fixture. It is usually better, from an economic standpoint, for a fixture to result in a small cost reduction for a process in constant use, than for a large cost reduction for a process used only occasionally. A common bench vise the left jaw is the immovable surface, and the right jaw is the movable clamp.

Most fixtures have a solid component, affixed to the floor or to the body of the machine and considered immovable relative to the motion of the machining bit, and one or more movable components known as clamps. These clamps (which may be operated by many different mechanical means) allow work pieces to be easily placed in the machine or removed, and yet stay secure during operation. Many are also adjustable, allowing for work pieces of different sizes to be used for different operations. Fixtures must be designed such that the pressure or motion of the machining operation (usually known as the feed) is directed primarily against the solid component of the fixture. This reduces the likelihood that the fixture will fail, interrupting the operation and potentially causing damage to infrastructure, components, or operators.

Fixtures may also be designed for very general or simple uses. These multi-use fixtures tend to be very simple themselves, often relying on the precision and ingenuity of the operator, as well as surfaces and components already present in the workshop, to provide the same benefits of a specially-designed fixture. Examples include workshop vises, adjustable clamps, and improvised devices such as weights and furniture.

The design of welding fixture for any manufacturing process has many objectives. The object are differs from one to another with respect to the type of operation to be done. The design objectives for designing for a welding fixture are

- To hold the part in most suitable position for welding
- To provide proper locating position.
- To provide proper suitable clamping to reduce distortion
- To provide proper heat control of the weld zone
- To provide clearance for filler metal
- To provide ease of operation and maximum accessibility to the point of weld

### 1.3 Problem statement.

Presently there are no perfect fixtures for the fuel tank mounting bracket, this is otherwise being welded by using hoist hook carriers and rotated to desired positions every time for welding. So it increases manufacturing lead time and increase man and money power also. So, it is necessary to develop a fixture to reduce the cycle time and having mass production.

#### 1.4 Objective.

- **Productivity:** This reduces operation time and increases productivity
- **Skill Reduction:** Any average person can be trained to use fixtures. The replacement of a skilled labor with unskilled labor can effect substantial saving in labor cost.
- **Durable & occupies small space.**

- Retain framework in various position into which it is swung.

### 1.5 Methodology.

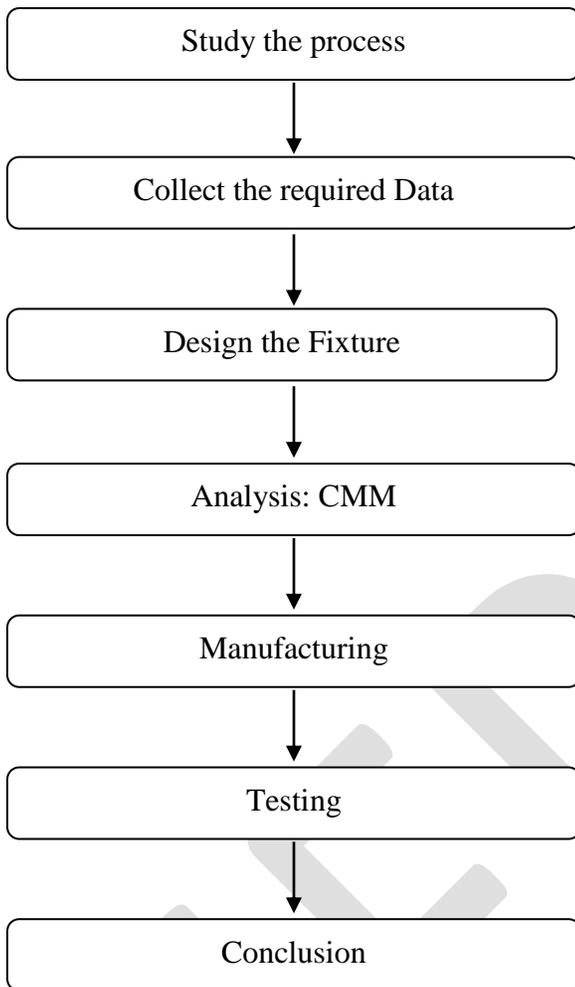


Fig No.1 Methodology flow chart.

The above flowchart shows the methodology of designing and manufacturing the welding fixture. The initial step is start with the material information of the bracket, machine specification, geometric dimensions and tolerances required to achieve on the bracket, and different parts of the bracket and their cad drawing. Then we have collect all the data required for designing the fixture as per the requirement of the bracket and then have to prepare the design the fixture with CAD drawing, after completion of cad model we have to analysis the fixture by CMM that is coordinate measuring machine of the fixture, When it is satisfied then we have to start manufacturing of fixture after that testing should be done either the fixture is made as per the designed and should work proper.

## 2. INTRODUCTION TO FUEL TANK MOUNTING BRACKET.

We have to design the welding fixture of the fuel tank mounting bracket of the Mahindra's bolero maxi truck. Before this we should have some basic information of the bracket like its parts, of which material it is to be made, etc. It consist of 6 parts as, L channel, L rib, C channel, strip and ribs which are 2 all the parts are made up of cold rolled steel. There 12 welding position from one side.

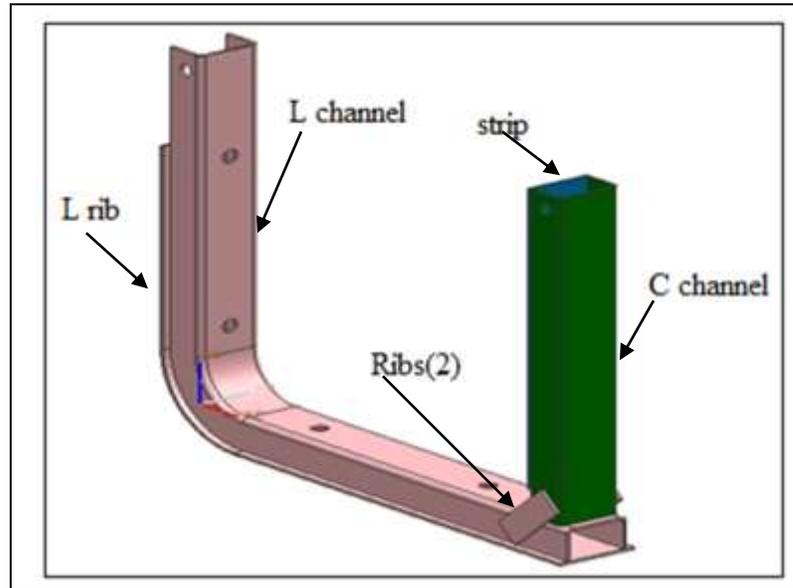


Fig No. 2 Fuel tank mounting Bracket and its parts.

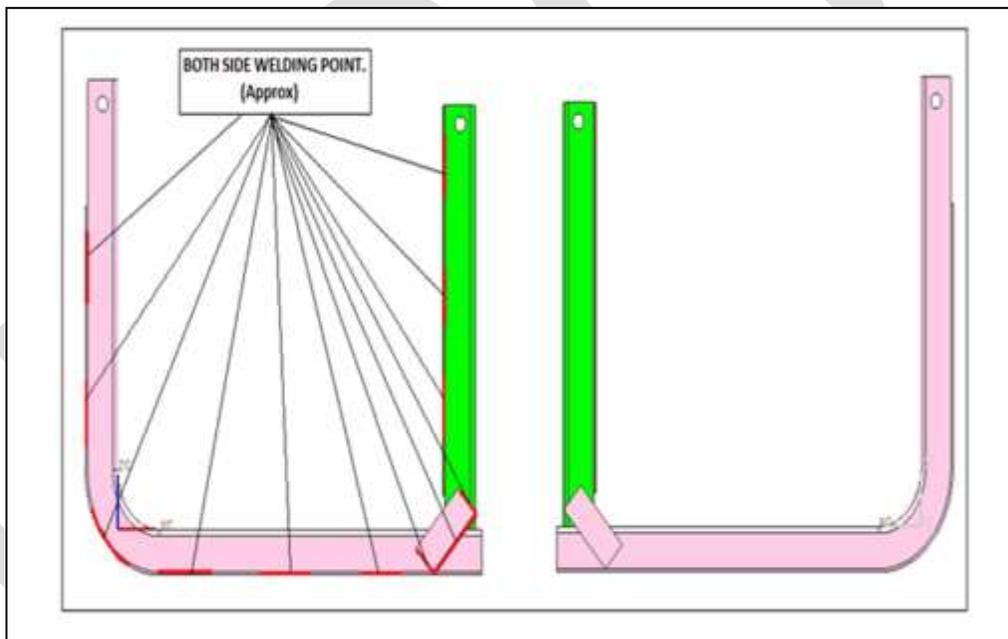


Fig No.3 welding points

### 3. WELDING FIXTURE FOR FUEL TANK MOUNTING BRACKET

As figure shows the assembly of welding fixture with fuel tank mounting bracket mounted. This welding fixture is specially design for this component to produce mass production and to reduce time consume.

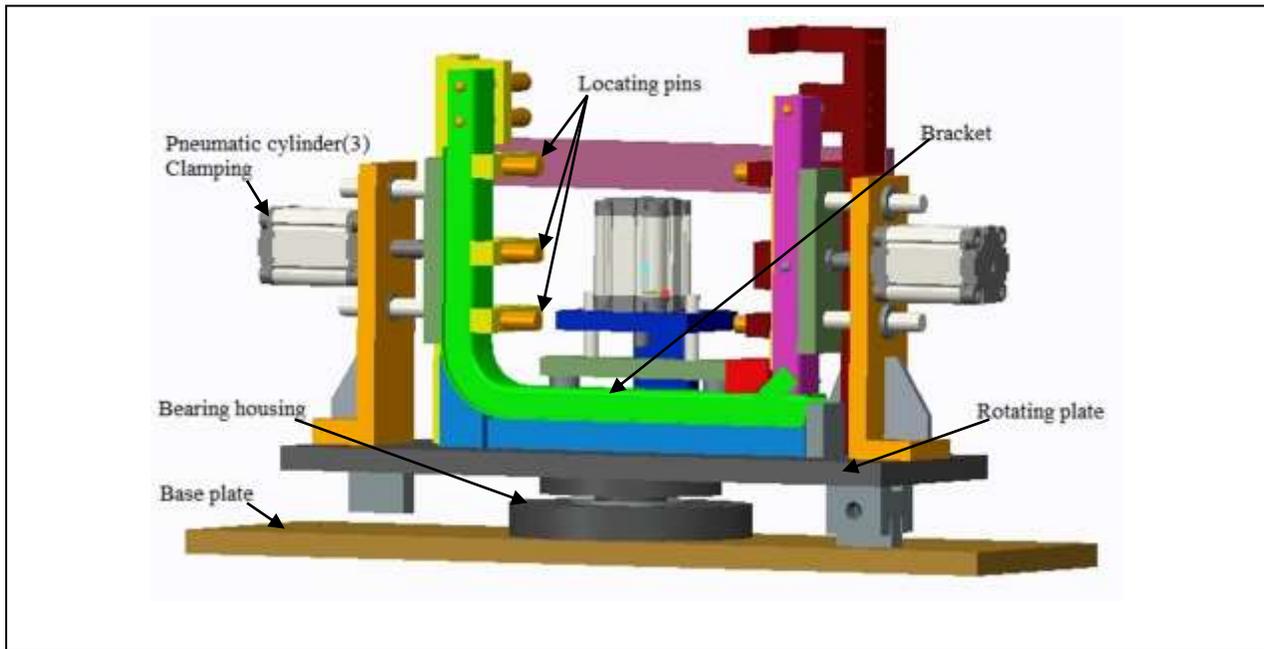


Fig No.4 welding fixture with bracket mounted

Basically this fixture is work as to reduce welder fatigue and to obtain the mass production. As shown in fig the main component is hold and supported in between the locaters and clampers. The rotating plate is mounted in plumber block to till the whole assembly of fixture up to 45°. There is a bearing housing on the rotating plate on which fixture rotating plate is mounted. That fixture rotating plate is rotating about 180° horizontally which reduce the time required to weld as compare to manual welding. Here is the distance is very important thing that should be as the distance is not maintain by the operator or by any technical reason the locaters locate that distance and it should not be accurate and alarm will be generated and the operator got an idea about that there is any misalignment in the component. same way the holes are presented for mounted that fuel tank on it if that holes are not present their or not made by the operator then the alarm will be generated an the operator get an idea that there is anything wrong and had to be solve and any misalignment is present in the fixture the whole system is stop and do not start welding on the component means the welding electrode is not come out from the welding arm.

#### 3.1 Fixture rotating cycle.

- From 0 degree (home Position) to 180 degree, in vertical axis.
- From 0 degree (home Position) to -180 degree, in vertical axis.

#### 3.2 Fixture tilting cycle

- From 0 degree (home position) to 45 degree, in horizontal axis.
- From 0 degree (home position) to -45 degree, in horizontal axis.

#### 3.3 Operation cycle.

- Operator will load all the child parts in fixture. (At this time fixture in Home Position).
- Operator will clamp all the parts with help of pneumatic Cylinder & he will start the welding manually.
- If there is any problem / missing of features while clamping there will be alarm & Co<sub>2</sub> welding machine will not start. When operator willed solved this issue alarm will stop & Co<sub>2</sub> welding machine will ready for welding.

#### 4. COORDINATE MEASURING MACHINEING (CMM) OF WELDING FIXTURE.

A coordinate measuring machine (CMM) is a device for measuring the physical geometrical characteristics of an object. It was carried out to check the positions of the locating points on the bracket are at their proper positions or not. There are total fourteen locating points on the bracket. The co-ordinates of these points were found out with the assistance of CMM and thus a report was generated with the help of software.

The CMM gives the detail idea about the points which are in the tolerance or out of tolerance. We check the co-ordinate of the locating position for the proper fixing of the bracket on the fixture with proper geometry. CMM is used to find the human error developed during the time of manufacturing of the fixture.

This report thus gives information about the different co-ordinates of the holes i.e. locating points.

There are 14 positions in the fixture as per the design and which needs to be located accurate position with respect to each other from reference.

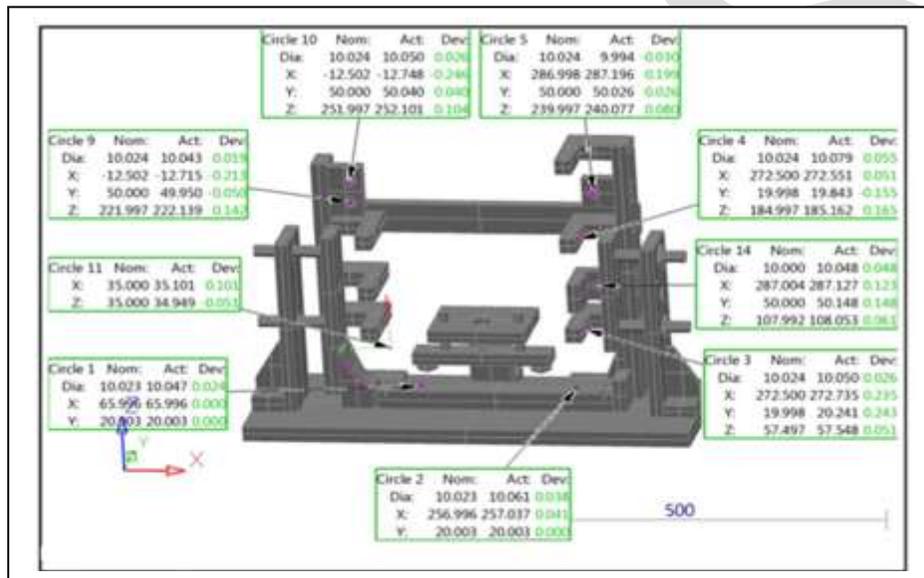


Fig No.5 CMM report 1

The CMM gives the idea about the locating position or locating holes are in tolerance or out of tolerance. The CMM defines the coordinate of the locating position as the manufacturing is done as per the designed. There is no error during manufacturing.

The CMM gives the actual reading of the locating position (circle) as they have high tolerance or low tolerance. It also gives the relation between the nominal and the measured dimensions of the locating position as deviation of the position and it also gives the any error if any.

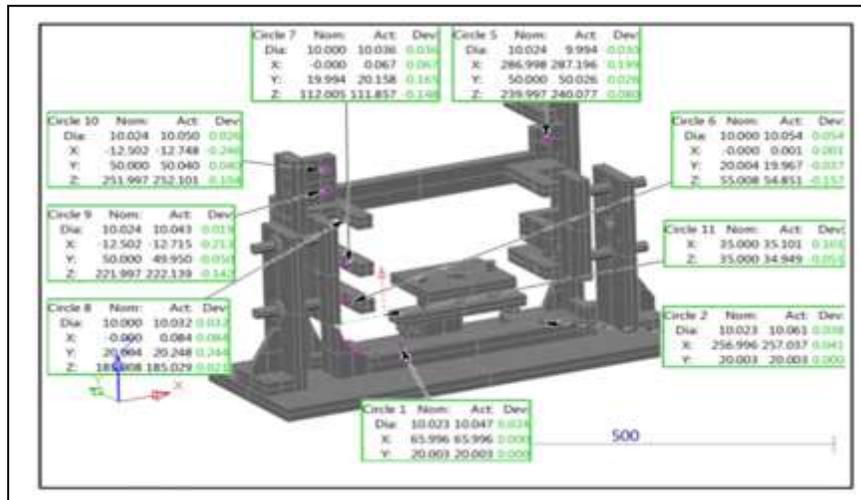


Fig No.6 CMM report 2

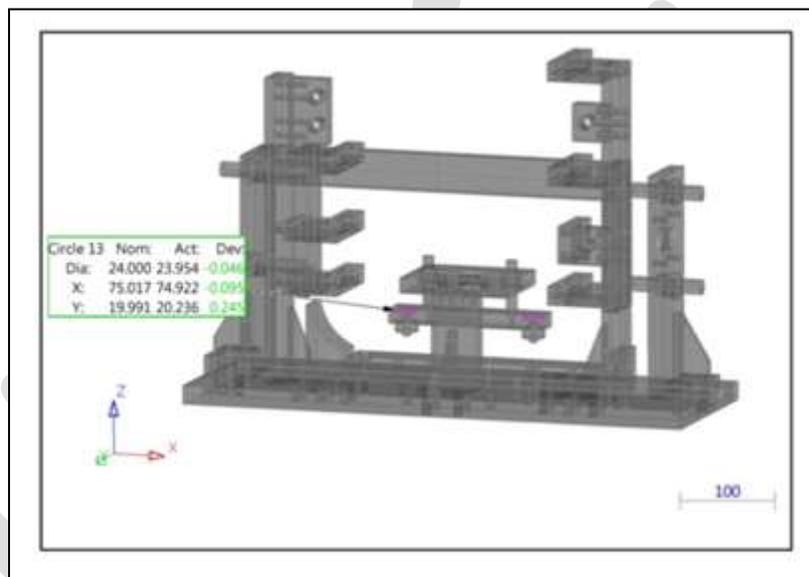


Fig No.7 CMM report 3

## 5. FUTURE SCOPE.

The welding fixture is designed to reduce the cost of production as well as be elimination being out of work and setting up of tools the fixture will increase the production rate by providing more number of parts in less time. Thus increasing the probability achieved from it. By using number of locating pins for proper location, the accuracy of the fixture increased. Thus allows in improvement of the part to be welded. It also provides an arrangement of interchangeability of the part which makes it flexible and eases the production.

It would also allow controlling quality control expenses of the organization. Thus enabling cost reduction in manufacturing of the parts to be produced. It will also enable to use less skilled labour which shows it reliance and importance and indirectly saving labour charges and number of labors required for the manufacturing process.

The automation part will allow improving the accuracy, reliability on fixture and elimination of wastage of unwanted parts. Last but not least it will improve the safety at work, thereby lowering the rate of accidents.

## 6. CONCLUSION

The Welding on number of fuel tank mounting bracket without changing the fixture is possible; hence it reduces work in progress, material handling time, work piece setup time and non-productive time. By using this fixture the misalignment occurring during Welding of fuel tank mounting bracket is effectively avoided, hence the accuracy of welding fatigue increases.

The efficiency and reliability of the fixture has enhanced as compared to earlier process. The cycle time required for loading and unloading the parts has reduced, thus improving and enabling interchangeability. It was found that conformability and stability has been achieved with help of fixture. The proposed fixture will hopefully achieve the production target and enhance the efficiency, increasing productivity, reducing elimination of parts, high quality of operation and reduce operation time and also reasonable.

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