

# Design Development of Multipurpose Jig and Fixture of Injection Moulding Die

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**Abstract:** This proposed method has to design and fabricate the Multipurpose Jig and Fixture, for that component which has been to reduce the manufacturing cycle time. When the component produced on a small size previously this is to produce the large quantities of requirements. The selective components requires for machining operations such as step milling, angle milling & boring and reaming. The Fixture design has will serve for the economic production for the component. The successful running of all over mass production depends upon the interchange ability to facilitate easy to assembly and reduction of unit cost. There is a necessary of special purpose tools which are used to facilitate the production operation like as machining, assembling, intersecting, etc. to save the calculation time and efforts, four formulas and three analysis models were introduced for calculation of possible UMFs during the assembly process. For the shortest computation time design process. A calibration method reduced from the cascading network relation has been presents to calibrate a symmetric device with an arbitrary test fixture by three measurements techniques. The result analysis indicates the obtained S-parameters of the test fixture have a large error. When the reflection coefficients of the DUT are low, but the calibrated S-parameters of the symmetric DUT is always accurate and even have lower errors than the results obtained by the TRL method.

**Keywords:** Moulding, Fixture, Multi-Purpose, optimization, Effect

## I. INTRODUCTION

The people's quest for manufactured goods has been growing rapidly over the years. Therefore, to meet up with the high demand, manufacturers have reacted by introducing innovative ways of manufacturing high quality products at a faster rate. Production processes has witnessed numerous changes and evolution with the introduction of numerous innovative manufacturing concepts which include Lean Production System, Cellular Manufacturing, Single Minute Exchange of Dies, as well as Take Time Analysis.

These creative approaches have necessitated the need for a reliable and cheaper tools and work-holding devices. As the efficient running of a manufacturing company which demands a prompt and simple work positioning strategy for correct operations depends largely on the interchangeability of machine components and work-pieces, to ensure un-complication of assembly, and unit cost reduction, as well as to become competitive, reduce the enormous manufacturing cost, and also increase their profitability, the industry has resorted to streamlining its supply chain in a bid to maintaining a very low amount of inventory.

This has also led to the demand for a better and cost effective work-holding devices which will ensure better quality products, reduce lead time, and also increase throughput. Also, although some machining operations are so straight forward, like in turning where the job is secured tightly on the chuck while the turning operations are easily performed, some jobs in other operations may not be easily held on either the three or four jaw chucks, and may also require the tools to be guided by the means of a different device. This explains the need for production standard work-holding devices too.

## II. OVERVIEW OF JIG AND FIXTURE JIG

A Jig is a one type of custom-made tool. It used to location and motion of another tool. A Jig is a primary purpose is to provide repeatability, accuracy, and interchange ability in the manufacturing products. The Jigs may be divided into

two types of classes, Boring Jig and Drill Jig. Boring Jigs are used to bore the holes. Drilling may be divided into two general types, open and closed types. Open Jigs are simple operations and it is done on side of the part. Closed or fix jigs are used for parts.

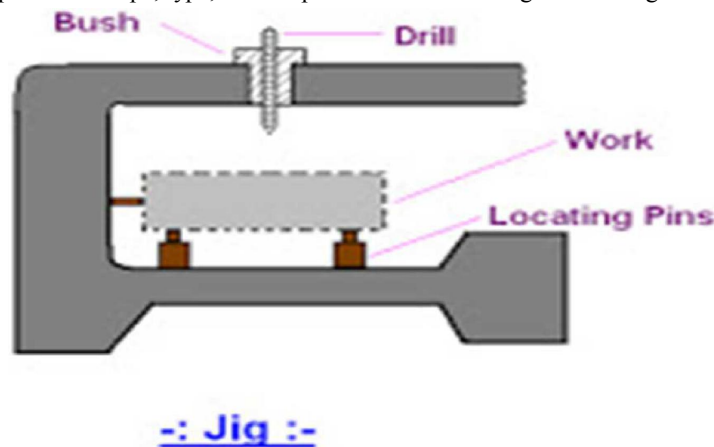
Jigs and fixtures are manufacturing tools that are employed to produce interchangeable and identical components. They are unique tool-guiding and work-holding devices designed specifically for machining and assembling large number of parts. Chennu, listed the following as the purposes of jigs and fixtures reduction of production cost, increase of production rate, high accuracy of products without any manufacturing defects, provision of interchange ability, easy machining of complex shaped parts, reduction of quality control costs, etc. Jigs and fixtures eliminate the need for a special set up for every work-piece thereby facilitating production and also ensuring that every work piece is manufactured within a predetermined tolerance. According to Meduettaxila, Jigs and fixtures “eliminate the necessity of a special set up for each individual part.” He observed that once a jig or fixture is appropriately set up, that any number of duplicate component scan be readily produced without additional set up. Also Mechnol, observed that the main advantages of Jigs and fixtures are “durability, setup reduction, improvement in productivity, reduced decision making in operation selected from the standard components. “The major difference between a jig and a fixture is that jigs guide the cutting tool to its precise position, as well as locating and supporting the work-piece during operations. The essential features of jigs and features include:

- Clamps position;
- Neatness of work-piece;
- Standardization;
- Idle time reduction;
- Set up time reduction;
- Hardened surfaces.

The application of jigs and fixtures in manufacturing operations lead to the production of faster, more accurate, and reliable products at a reduced cost.

### III. JIG

A jig is a work-holding device that supports, holds, locates a work-piece and also guides the cutting tool for the desired machining operations. Its main objective is to ensure high degree of precision, interchangeability, and duplication in products manufacturing, it is also applied to manipulate the location and movement of other tools. Nanthakumar and Prabakaran (2014), explained that a jig is a type of custom-made tool used for the location and motion of another tool. They observed that the primary purpose of a jig is to provide repeatability, accuracy, and interchangeability in the manufacturing of products. Although the most common jigs are the drilling and boringJigs, they are all identical except for the shape, type, and the position of the bushings for drilling or boring.

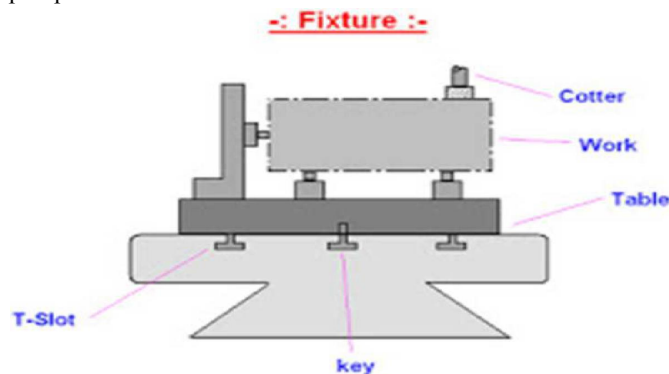


According to Joshi (2010), Jigs are imparted with tool guiding elements such as drill bushes, which regulate the tool to the right position in the work piece. He observed that they are rarely clamped on the machine table as it is essential to push the jig on the table to align the numerous bushes in the jig with the spindle of the machine. The different types of jigs are template jig, drilling jig, open type jig, etc.

#### **IV. FIXTURE**

Fixtures are rigid and sturdy mechanical devices which allow fast and precision machining with reliable quality, interchangeability, and lead time reduction. As a work holding device, fixtures do not position, guide, and locate the cutting tool, as it is achieved by making necessary adjustments on the machine. Kaija, and Heino (2006), explained that the “main purpose of a fixture is to locate and in some cases hold a work-piece during either a machining operation or some other industrial processes.” He pointed out that what makes fixtures unique is that they are all manufactured to fit a particular shape or part.

A Fixture is a work holding device used in the manufacturing industries. Fixtures are used to securely locate the position or location and to support the work, ensured that all parts produced using the fixture will maintain conformity and interchange ability. Using this fixture improves the economy of production by allowing smooth operation and quick transition from part to part production.



Fixtures often fastened to the machine table, are made to hold the work piece firmly and in the desired position during machining operations. Joshi (2010), stated that there are sometimes an arrangement in the fixture for adjusting the tool with respect to the work-piece/fixture, although the tool is not guided like in a jig. While fixtures are always identified by the machine tool where they are applied, they have broader applications than jigs, and also manufactured for operations where the cutting tools cannot be easily maneuvered like the drilling or boring tools. The different types of fixtures are welding fixture, tapping fixture, milling fixture, boring and drilling fixture, milling fixture, turning fixture, etc. The Jig and Fixtures having some essential features, they are;

- a. Reduction of Idle time.
- b. Cleanliness.
- c. Standardization.
- d. Hardened surfaces.
- e. Position of clamps

#### **V. ELEMENTS OF JIGS AND FIXTURES**

The body, Clamping devices, Locating devices, and Tool guide/bushes are the major elements of jigs and fixtures.

The Body:

As the most outstanding element of jigs and fixtures, the body is constructed by welding of different slabs and metals usually mild steel or by casting of cast iron. After the fabrication, it is often heat-treated for stress reduction as its main objective is to accommodate and support the job.

The different types of jig bodies are as follows:

- Channel body type – this is fabricated from the regular steel channel.
- Box body type – usually made very light, the box type jig body is adopted where a work-piece needs drilling in various parts, hence the jig is fabricated to have a required amount of drill bush plates.
- Plane body type – this is the most common type of jig body and is often applied when the work-piece requires drilling or boring, hence the provision of drill bushes on it.
- Leaf body type – usually made from block of steel as it holds and supports heavy components.
- Built-up body type – this is made from standard steel.

#### **A. Clamping Devices:**

Without sacrificing efficiency and effectiveness, the clamping devices must be very simple and easy to operate. Apart from holding the work-piece securely in place, the strong point of clamping devices is its ability to withstand the strain of the cutting tool during operations. The bench vice is a popular example of a clamping device. The need for clamping the work-piece on the jig or fixture is to apply pressure and press it against the locating components, thereby fastening it in the right position for the cutting tools. The familiar clamping devices include:

Clamping screws – they are used for not too rigid clamping. Hook bolt clamp - a simple clamping device generally used where the normal clamping tip cannot fit in. Latch clamp – this is a unique clamp which provides space for the loading and the unloading of a work-piece through its latch or lid. Other clamping devices are the C – clamp, the Bridge clamp, and the Heel clamp,

#### **B. Locating Devices:**

Made with hardened steel and with different designs, the pin is the most popular device applied for the location of work-piece in jigs and fixtures. The pin's shank is press-fitted or driven into a jig or fixture. The locating width of the pin is made bigger than the shank to stop it from being pressed into the jig or fixture body because of the weight of the cutting tools or work-piece. The pins are classified as follows:

- Locating pins – the locating pins are used for the location of the work-piece when completed or reamed holes have been provided on the work-piece. The two types of locating pins are cylindrical and conical locating pins.
- Jack pins – jack pins also referred to as spring pins are used for the location of work-piece whose dimension will vary during operation. The pin is designed to rise under spring pressure or in the contrary the weight of the work-piece pushes it down. As the position of the work-piece is firmly fixed, the locking screw is used to fasten the pin in the desired position.
- Support Locating/Rest pins – these pins which ensure reliable and secure location are made to be either curved or flat. Those with flat heads are often used to provide support and location to machine surface, as more contact area is accessible during location. Because of their stability, the head support locating pins are for supporting coarse or rough surfaces during machining.

#### **C. Jig Bushing or Tool Guide**

Guiding parts like jig bushings and templates which must be wear resistant, interchangeable, and precise, are used to locate the cutting tool relative to the component being machined. Jig bushes are applied in drilling and boring, here for the drill to pass through, a bush fits into the hole of the jig.

Bushes are mainly made of reliable grade of tool steel in order to ensure hardening at a low temperature and also reduce the risk of fire cracking. Although, hardened steel bushes are preferred for guiding reamers, drills, and taps, the guiding tool bushings can also be made of cast iron. The jig bushings are categorized into three: the linear wearing bushes, press-fit wearing bushes, and renewable wearing bushes. Fundamental principles of Jig and fixture:

- i. Locating Points.
- ii. Fool Proof.
- iii. Clamping Device.
- iv. Reduction of idle time.
- v. Weight of Jigs and Fixture.

#### **D. Materials used in Jig and Fixture:**

The Jig and Fixture are made from variety of materials, some of which can be hardened or resist. It sometimes use nonferrous like as phosphor bronze to reduce the wear of mating parts or nylons or fibers to prevent damage. Most of us the high speed material has been used for this production..

#### **VI. IMPORTANT CONSIDERATIONS WHILE DESIGNING JIGS AND FIXTURES**

Designing of jigs and fixtures depends upon so many factors. These factors are analyzed to get design inputs for jigs and fixtures. The list of such factors is mentioned below

- (a) Study of work piece and finished component size and geometry.
- (b) Type and capacity of the machine, its extent of automation.
- (c) Provision of locating devices in the machine.
- (d) Available clamping arrangements in the machine.
- (e) Available indexing devices, their accuracy.
- (f) Evaluation of variability in the performance results of the machine.
- (g) Rigidity and of the machine tool under consideration.
- (h) Study of ejecting devices, safety devices, etc.
- (i) Required level of the accuracy in the work and quality to be produced.

#### **VII. PROBLEM STATEMENT**

- 1) Previous techniques are more time consuming.
- 2) More efforts & skills are required for replacement of jobs.
- 3) It may cause errors due to improper skills.
- 4) Chances of slippage are more while higher cutting force

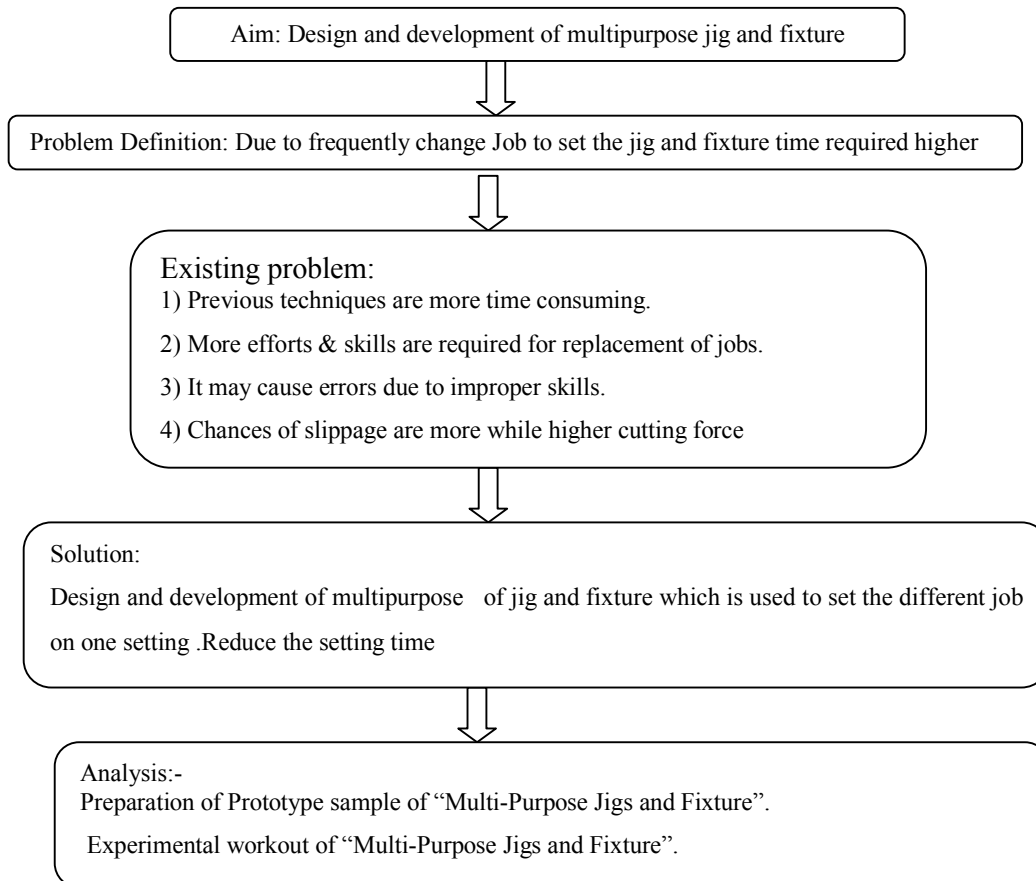
#### **VIII. NECESSITY OF WORK**

This proposed method has to design and fabricate the Multipurpose Jig and Fixture, for that component which has been to reduce the manufacturing cycle time. When the component produced on a small size previously this is to produces the large quantities of requirements. The selective components requires for machining operations such as step milling, angle milling & boring and reaming. The few operations where been done in CNC and rest operations are carried out in Conventional machine tool. The proposed method has to be design and fabricated the multi-operational Fixture for the complete machining operations in a single machining center. The Fixture design has will serve for the economic production for the component.

#### **IX. OBJECTIVE OF WORK**

1. Analytical design of “Multi-Purpose Jigs and Fixture”.
2. Modelling and Simulation of “Multi-Purpose Jigs and Fixture”.
3. Preparation of Prototype sample of “Multi-Purpose Jigs and Fixture”.
4. Experimental workout of “Multi-Purpose Jigs and Fixture”.
5. Study of comparative result of “Multi-Purpose Jigs and Fixture”.

**X. METHODOLOGY**



**XI. ACKNOWLEDGMENT**

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