International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395 -0056
Volume: 04 Issue: 05 | May -2017 www.irjet.net p-ISSN: 2395-0072

Study & Design of Jig and Fixture for Base frame of Canopy Fabrication of Generator

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Abstract – *Base frame is very important part of generator canopy. It should be accurately machined with acceptable tolerance otherwise the engine will not mounted properly and the canopy will be rejected. The jigs and fixtures assure that there will be accurate assemblage of part so the main components of generator like engine, alternator will mounted properly on base frame. As we know the jigs and fixtures are economical ways to getting mass production. The tolerance of engine and alternator is only ±1 mm in bending but the distance between engine and alternator mounting channel is fixed.*

Key Words: Jigs, Fixtures, base-frame of canopy.

1. INTRODUCTION

The Jigs and Fixtures are special purpose tools which are used to maintain accuracy and ensure mass production in manufacturing any component. The mass production is based on interchangeability by which every part will be produced with given tolerance. Jigs and Fixtures relates between the references which is taken in consideration for initial phase of design.
Once a Jig or Fixture is designed we can produce identical parts of specific object without additional setup. The accuracy is also maintained throughout the parts

1.1 Jigs

It is a work holding device that holds, supports and locates the work piece it also guides cutting tool for specific operation. The jig may or may not be fastened to the machine table whereas the fixture should be fastened to the machine table precisely. As far as jigs are concerned, the cumulative output in terms of production units, manufacturing time, labour required and ease of operation is more important.

1.2 Fixtures

It is a work holding device that holds, supports and locates the work piece for operation but does not guide cutting tool. The task of fixture is to provide a reference surface. Purpose of fixture is to locate and hold the workpiece. The fixture is similar device to jig but as name suggests it is fixed. Utilizing the concept of standardization, fool proofing will reduce the manufacturing cost of jigs and fixtures. Similarly, suitable choice of operating mechanism of the jigs and fixtures according to the working environment will also help reduce the manufacturing cost.

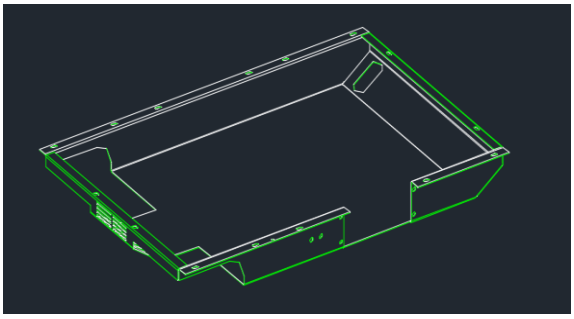

Fig -1: Base-frame design.

The purpose of jig and fixture

The basic purposes of developing and using suitable jigs and fixtures for batch production in machine shops are:

1. To eliminate marking, punching, positioning, alignments etc.
2. Easy, quick and consistently accurate locating, supporting and clamping the blank in alignment of the cutting tool
3. Guidance to the cutting tool like drill, reamer etc.
4. increase in productivity and maintain product quality consistently
5. To reduce operator's labour and skill – requirement
6. To reduce measurement and its cost
7. Enhancing technological capacity of the machine tools
8. Reduction of overall machining cost and also increases in interchangeability.

2. LITERATURE REVIEW

1. **Designing and evaluating of jig for holding cylindrical parts for mass production for drilling operation-** This paper gives us information about designing and evaluating of jig for mass production of cylindrical parts for mass production.

2. **Design and Finite Element Analysis of JIGS and Fixtures for Manufacturing of Chassis Bracket –** This paper gives the design and analysis of jigs and fixtures which is used n manufacturing of chassis bracket in Bajaj car. This paper gives the basics of jigs and fixtures, the difference between jigs and fixtures. The advantages of designing & methodology of jigs and fixtures.

3. **A Review on Design of Fixtures –**This paper gives the idea about fixtures and need of fixture in an industry in order to maximizing the profit. Steps for designing a fixture are given with the help of these steps we designed the fixture. Important considerations also discussed for designing of jigs and fixtures. Various principles of locations are also given in order to constrain the motion in various axis.

4. **Jig and Fixture Design-** This paper gives us the information about redesigning the fixture using CATIA software. After redesigning the fixture we find the fixture more useful compared to earlier design.

5. **International Journal of Research in Advent Technology –** This paper gives the information about design of fixture and types of fixture. The types of fixture are explained.

6. **Fixture design criteria phase II-** This paper gives us the standard elements of fixture design e.g. mounting elements, locating elements.

7. **A REVIEW ON DESIGN OF FIXTURE-** Design considerations in fixtures are explained briefly e.g. strong frame of fixture, less efforts for clamping.

3. Selection of Material

There are a wide range of materials from where jigs and fixtures could be made, to resist tear and wear, the materials are often tempered and hardened. Also, phosphor bronze and other non-ferrous metals, as well as composites, and nylons for wear reduction of the mating parts, and damage prevention to the manufacturing part is also used. Some of the materials are discussed below:

1. **Phosphor Bronze** : Phosphor bronze is used in the production of jigs and fixtures for processes that involve making of interchangeable nuts in clamping systems like vices, and also incorporated feedings that require screws. As the manufacturing of screws is very expensive and also wastes a lot of time, the reduction of their tear and wear is often achieved by using replaceable bronze mating nuts made with phosphor bronze.

2. **Die Steels**: The three variants of die steel - high chromium (12 %), high carbon (1.5 to 2.3%), and cold working steels are applied in the production of jigs and fixtures for the making of thread forming rolls, as well as cutting of press tools. When alloyed with vanadium and molybdenum for it to retain toughness at very high temperature, die steels are applied in the fabrication of jigs and fixtures that are used in high temperature work processes which include extrusion, forging, and casting processes.

3. **High Speed Steels**: High speed steels which contain more quantity of tungsten and less quantity of chromium and vanadium has high toughness, hardenability, hardness retention at high temperature, and good wear, tear and impact resistance. When tempered, they are applied in the production of jigs and fixtures for reaming, drilling, boring, and cutting operations.

4. **Carbon Steels**: When tempered with oil, carbon steels are applied in the making of some jig and fixture parts which are exposed to tear and wear like the locators and jig bushes.

5. **Mild steels** : Mild steel which contain about 0.29% of carbon are very cheap and because of their easy availability are often the choicest material for the making of jigs of fixtures.

6. **Other materials** :For the making of jigs and fixtures include: Nylon and fiber, steel castings, stainless steel, cast iron, high tensile steels, case hardening steels, and spring steels.

4. RESEARCH METHODOLOGY

1. **Study of manufacturing process of base-frame-** while studying of the base-frame manufacturing we noticed that there is less tolerance of ±1mm, and it is the most important part of generator canopy on basis of which canopy is accepted or rejected. so, it is important that the base-frame should be manufactured with given allowable tolerance.

2. **Design the base-frame model in CAD software-** While designing the base-frame in CAD software we have taken the standard dimensions (in mm) of base-frame and designed it.

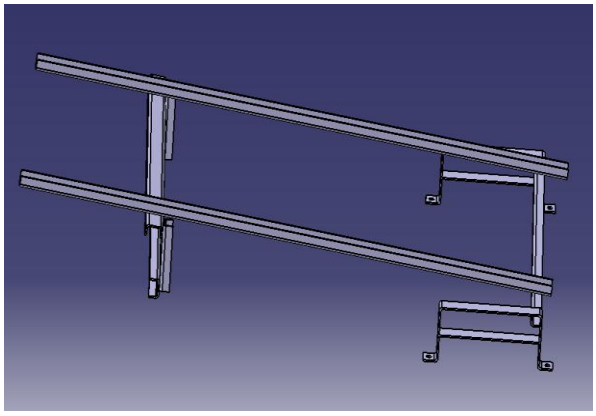

Fig. Actual Designed Fixtrue

3. **Design the fixture**

In the stage of designing the fixture we have measured the center distance between two holes an matched them for fixing the motion. Successful fixture designs begin with a logical and systematic plan. With a complete analysis of the fixture's functional requirements, very few design problems occur. When they do, chances are some design requirements were forgotten or underestimated. The workpiece, processing, tooling and available machine tools may affect the extent of planning needed. Preliminary analysis may take from a few hours up to several days for more complicated fixture designs. Fixture design is a fivestep problem-solving process. The following is a detailed analysis of each step.

Step 1: **Define Requirements**

To initiate the fixture-design process, clearly state the problem to be solved or needs to be met. State these requirements as broadly as possible, but specifically enough to define the scope of the design project.

Step 2: Gather/Analyze Information

Collect all relevant data and assemble it for evaluation. The main sources of information are the part print, process sheets, and machine specifications. Make sure that part documents and records are current. For example, verify that the shop print is the current revision, and the processing information is up-to-date. Check with the design department for pending part revisions. An important part of the evaluation process is note taking. Complete, accurate notes allow designers to record important information. With these notes, they should be able to fill in all items on the "Checklist for Design Considerations." All ideas, thoughts, observations, and any other data about the part or fixture are then available for later reference. It is always better to have too many ideas about a particular design than too few. Four categories of design considerations need to be taken into account at this time: workpiece specifications, operation variables, availability of equipment, and personnel. These categories, while separately covered here, are actually.

Step 3: Develop Several Options

This phase of the fixture-design process requires the most creativity. A typical workpiece can be located and clamped several different ways. The natural tendency is to think of one solution, then develop and refine it while blocking out other, perhaps better solutions. A designer should brainstorm for several good tooling alternatives, not just choose one path right away. During this phase, the designer's goal should be adding options, not discarding them. In the interest of economy, alternative designs should be developed only far enough to make sure they are feasible and to do a cost estimate. The designer usually starts with at least three options: permanent, modular, and general-purpose work holding. Each of these options has many clamping and locating options of its own. The more standard locating and clamping devices that a designer is familiar with, the more creative he can be. Areas for locating a part include flat exterior surfaces (machined and non machined), cylindrical and curved exterior surfaces. The exact procedure used to construct the preliminary design sketches is not as important as the items sketched. Generally, the preliminary sketch should start should start with the part to be fixtured. The required locating and supporting elements, including a base, should be the next items added. Then sketch the clamping devices. Finally, add the machine tool and cutting tools. Sketching these items together helps identify any problem areas in the design of the complete fixture.

Step 4: Choose the Best Option

The total cost to manufacture a part is the sum of per-piece run cost, setup cost, and tooling cost. Step 5: Implement the Design

The final phase of the fixture-design process consists of turning the chosen design approach into reality. Final details are decided, final drawings are made, and the tooling is built and tested. The following guidelines should be considered during the final-design process to make the fixture less costly while improving its efficiency.

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5. RESULTS

The production rate of canopy increased as the time is reduced for welding of base-frame. The time for welding the base-frame is about 1.5 hrs. With the help of fixture the manufacturing time reduced by 15 min. for each base-frame.

So,

We can calculate the time reduced to produce base-frame

Time saved can be calculated as follows

Time saved by each base-frame = 15min

Daily production = 6 nos.

Total time saved per day =6 *15

=90 min

= 1.5 hrs.

So, we can say that every day one extra base-frame is produced

Monthly production = 26 (increased production of base-frame)

6. CONCLUSIONS

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. They 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. The design of jigs and fixtures is dependent on the operation type as well as the machine tool to be used for the operation. They are fabricated with heat-treated steel that are corrosion and wear resistant. There are numerous advantages that are associated with the use of jigs and fixtures, they include: production increase, low variability in dimension thereby leading to consistent quality of manufactured products, manufacturing cost reduction, interchangeability and high accuracy of parts, reduces the need for inspection and quality control expenses, reduces accident as safety is improved, semi-skilled machine operators can easily use them thereby saving the cost of manpower.

By using this fixture the production of base-frame is increase 1 in no. per day.

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