

Design and Manufacturing of Hydraulic Fixture

Vishwajeet Medsinge¹, Vaibhav Chougale¹, Sourabh Jadhav¹, Rohan Divate¹, Suyog Arde¹, S. R. Gavali²

Student, Department of Mechanical Engineering, D. Y. Patil College of Engg. & Technology, Kolhapur, India¹

Asst. Professor, Department of Mechanical Engineering, D. Y. Patil College of Engg. & Technology, Kolhapur, India²

ABSTRACT : In machining fixtures, minimizing work piece deformation due to clamping and cutting forces is essential to maintain the machining accuracy. The recent trends in industry are towards adopting the hydraulic techniques, because it save time generates accuracy and it is having some flexibility. 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. The evaluated fixture uses hydraulic vertical swing clamps for holding the work piece driven by hydraulic power pack. Thus the new fixture achieves automatic and simultaneous clamping of parts.

KEYWORDS : fixture, accuracy, clamping, productivity, power pack

I. INTRODUCTION

Hydraulic Fixture is a clamping system that uses high-pressure liquids to power clamps and hold a work piece in place. Hydraulically clamped fixtures have many advantages over manually clamped fixtures. In most cases, these benefits reduce costs for manufacturers allowing them to justify the initial investment for a hydraulic clamping system. Fixture is a special purpose tool which is used to facilitate production (machining, assembling and inspection operations) when work pieces are to be produced on a mass scale. Fixtures provide a means of manufacturing interchangeable parts since they establish a relation, with predetermined tolerances, between the work and the cutting tool. Once a fixture is properly set up, any number of duplicate parts may be readily produced without additional set up. The current system uses manual clamping of fixtures for holding the work piece in the proper position while machining operations is being done on the part due to which rejection rate is high. These operations have to be done hundreds of times per day this may cause considerable fatigue to the operator, thereby reducing his efficiency. Also the time spent in this activity can seriously affect the production. These problems can be overcome by making the performance of fixture automatic. Providing the proper work holding platform is an important issue in any kind of operations performed on the work component. In this way automation has played a vital role in providing a reliable and fast clamping system which will reduce the cycle time of clamping with the increase in accuracy thus decreasing the possible damages to the work piece.

II. OBJECTIVES

- 1) To increase Productivity: More parts will fit within machine envelope due to the high clamp forces generated with small hydraulic components.
- 2) For Consistent Clamping Forces: Every cycle, parts are clamped with the same clamping force, eliminating variables and improving process stability.
- 3) TO Achieve Repeatable Clamp Location: Every cycle, parts are clamped in the same location eliminating the variability in part deflection from clamping forces.
- 4) To Eliminates Human Error: Assurance that every clamp will be actuated with every cycle, eliminating human error and missed steps.
- 5) To Perform Faster: Load and unload times and more productivity when cycle times are operator dependant.
- 6) To Increase Ergonomic Efficiency: Allows operators to be consistently more productive with less effort.
- 7) To Improved Part Stability: Hydraulic work supports can be used to support the part and/or dampen machining forces without distorting the work piece. Manual work supports are easily ignored, distort the part and cause miss-loads.
- 8) To achieve Flexibility: Sophisticated clamping sequences can be developed with "live" hydraulic systems. Clamping can be sequenced automatically during the machining cycle to provide clearance for cutting tools, to remove forces for finish cuts of close tolerance features, retain parts for robotic loading, reduce cycle times and improve productivity.

III. LITERATURE REVIEW

Review Paper on Design Strategies for Manufacturing Fixtures as per Machine Operations Supriya A. Patil Dr. S. S. Goikar Volume 2, Issue 3 Asian Journal of Convergence in Technology Issn No.:2350-1146, I.F-2.71

- To make the standard machine tool, more versatile to work as specialized machine tools, the use of special production tools, jigs and fixtures is necessary. They are normally used in large scale production by semi-skilled operators; however they are also used in small scale production by when interchangeability is important. Various areas related to design of Fixture has been studied and described by various authors. Those ideas and techniques should be summarized and needs to be applied practically in industries. The content gives the thorough idea of Fixture design process. This strategy can be used for further designing of fixture for any one. Also there are various alternatives which allow us to alter the design for best results

Kiran Valandi, M. Vijaykumar ,Kishore Kumar S, Development, Fabrication and Analysis of Fixture, International journal of science technology management and research; 2014, Vol.3, Issue 4

A fixture is designed, built to hold, support and locate every component to ensure that each is drilled or machined with accuracy and manufactured individually. A fixture can be designed for the particular job using production tools which make the standard machine tool more versatile to work as specialized machine tools. They are normally used in small scale production by semi skilled operators. This dissertation work aims at designing a fixture used for performing machining operations at certain angle (102.5 degree) on the Crank case used in commercial vehicles. The design of the fixture is simple, the loading and unloading of component is very easy. At a time all the operations such as milling, boring, drilling, tapping can be done in a single set up which in turn decreases the handling

Sridharakeshava K B, Ramesh Babu. K, “An Advanced Treatise on Jigs and Fixture Design” International Journal of Engineering Research & Technology (IJERT) ISSN: 2278-0181 Vol. 2 Issue 8, August – 2013

Jigs and fixtures are special production tools which make the standard machine tool, more versatile to work as specialized machine tools. Even with the advancement of manufacturing industries, there is a continued use of jigs and fixture either in some form or other, either independently or combination with other systems. This paper addresses the jigs and fixture design verification issue. In this paper, the work piece location, clamping stability under dynamic machining and frictional conditions at the interface between jigs and fixture elements and work piece are taken into account

Shailesh S Pachbhai and Laukik P Raut, “Design and development of Hydraulic Fixture for machining Hydraulic lift Housing” International Journal of Mechanical Engineering and Robotic Research ISSN 2278 – 0149 Vol. 3, No. 3, July, 2014.

In machining fixtures, minimizing work piece deformation due to clamping and cutting forces is essential to maintain the machining accuracy. The recent trends in industry are towards adopting the hydraulic techniques, because it save time generates accuracy and it is having some flexibility. Hydraulic Fixture is major application in the field of designing, where in several software's are available for the purpose of design. The proposed fixture will not only provides the repeatability and high productivity, but also offers a solution, which reduces work piece distortion due to clamping and machining forces. All the values of deformation and von misses stress calculated with ANSYS software is comparatively lower than standard values and hence, we can conclude that design is safe. As per calculations, the proposed fixtures have a direct impact on product quality, productivity and cost.

N. P. Maniar, D. P. Vakharia, “ Design & Development of Fixture for CNC –Reviews, Practices & Future Directions” International Journal of Scientific & Engineering Research Volume 4, Issue 2, February-2013 ISSN 2229-5518.

Various areas related to design of fixture are already been very well described by various renowned authors. This section reviews some of the developments in fixture design and proposes directions for future research initiatives. Fixtures have a direct impact upon product manufacturing quality, productivity and cost, so much attention has already been paid to the research of computer aided fixture design (CAFD) and many achievements in this field have been reported. Many academic and applications papers have been published in this area. But still Fixture design needs to be tested and evaluated in real manufacturing environments and integrated with other design activities, which often are related with production resources, equipment, cost and machining processes, etc. Another important research is on the integration of various techniques directly used in computer aided fixture design. As we know, an optimal fixture solution is a hybrid result of many different considerations, such as tolerance configuration, stiffness configuration, machining process, etc. Hence attention should be paid on the establishment of a systematic way of integrating various

techniques, such as Computer Aided Mass Balancing Method (CAMBM) and FEA methods for work piece-fixture system.

S.D.V.V.S.B.Reddy, P.Satish Reddy, V. Subrahmanyam, “Design And Analysis Of Machining (Hydraulic) Fixture For AVTEC Transmission Case Component” International Journal of Science Engineering and Advance Technology IJSEAT, Vol 2, Issue 7, July - 2014 ISSN 2321-6905.

These instructions give you basic guidelines for preparing papers for conference proceedings. Fixture is a work holding device used in the manufacturing industry. Fixture’s primary purpose is to create a secure mounting point for a work piece, allowing for support during operation and increased accuracy, precision, reliability, and interchange ability in the finished parts. This paper present design of hydraulic fixture for engine side. This component is a part of three wheeler auto. The operation to be performed is & finishes milling of flange, drilling, reaming & spot facing on VMC. The evaluated fixture uses hydraulic swing clamp, hydraulic cylinders, and hydraulic work support for holding the work piece driven by hydraulic power pack. Thus the new fixture achieves automatic and simultaneous clamping of parts.

IV. FIXTURE ELEMENT

clamped fixtures have many advantages over manually clamped fixtures. In most cases, these benefits reduce costs for manufacturers allowing them to justify the initial investment for a hydraulic clamping system. Hydraulic clamping enables manufacturers to put more intelligence into the fixture eliminating human error and producing a more stable, predictable processes no matter who the operator is or what production shift your machine runs.

The use of fixtures has two fold benefits. It eliminates individual marking; positioning and frequent checking before machining operation starts, thereby resulting in considerable saving in set-up time. In addition, the usage of work holding devices saves operator lab or through simplifying locating and clamping tasks and makes possible there placement of skilled workforce with semiskilled labour , hence effecting substantial saving in labour cost which also translates into enhanced production rate. Furthermore, the use of well-structured fixtures with high relocating and clamping rigidity would allow for increase in cutting speeds and feeds, thereby reducing tm, hence improving production rate. Besides improving the productivity in terms of the rate of production.

So this hydraulic fixture’s element are as follows with their dimensions

A. Base Plate

It is made by mild steel. Structure of base plate is rectangular type. It is rigid and can withstand high vibrations.

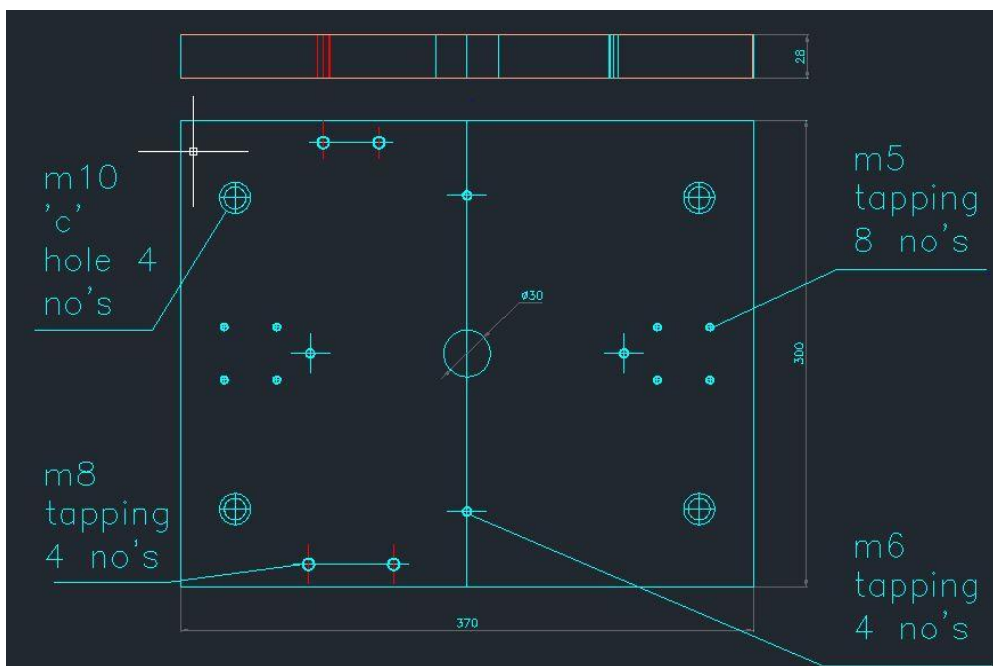


Fig.1 Base plate drawing

B. Locating Element

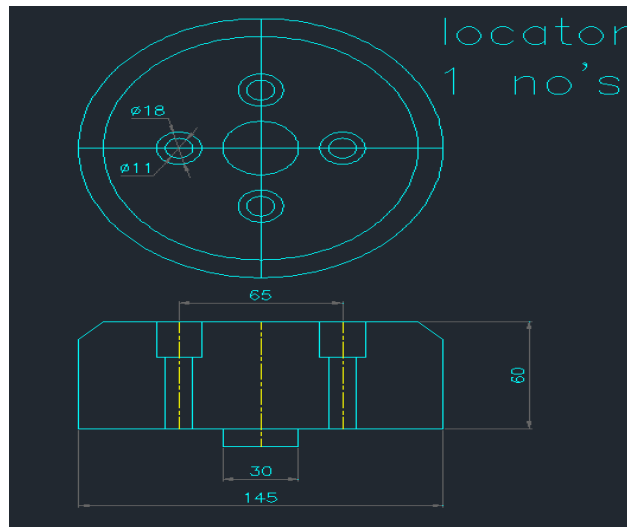


Fig.2 Locator 1 drawing

C. Hydraulic Cylinder

There are 2 hydraulic cylinder for clamping purpose which is of 30kg force

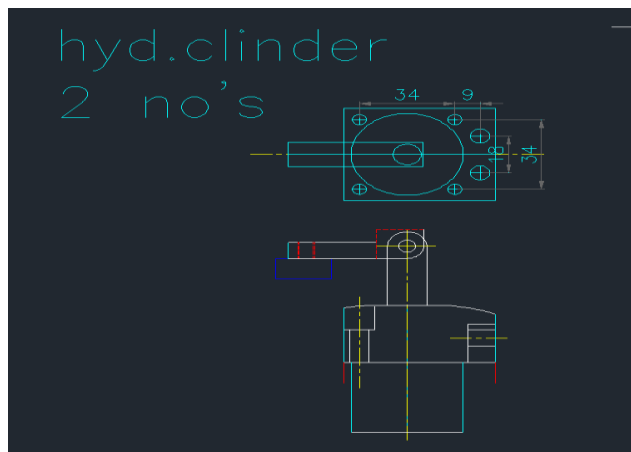


Fig.3 Cylinder Drawing

D. Spring Tensioner

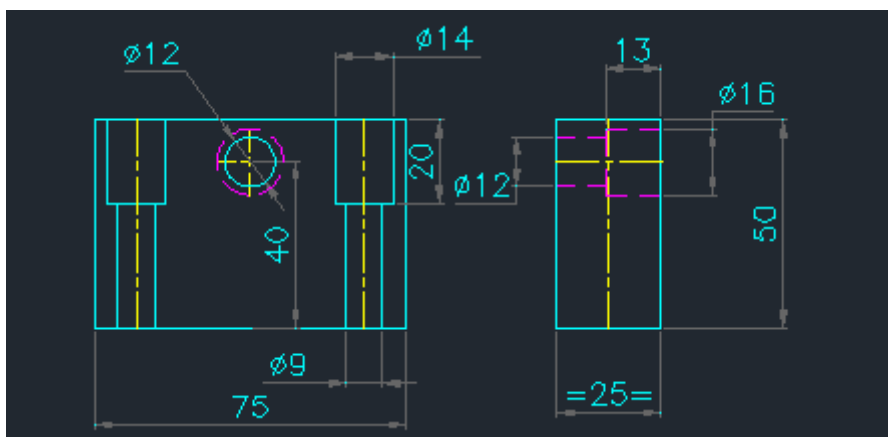


Fig.4 Spring Tensioner Drawing

E.Rest Pad

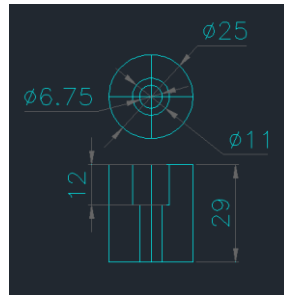


Fig.5 Rest Pad Drawing

Table 1: Materials for Fixture Element

Element	Material
Base plate	M. S.
Locator	EN-8
Spring Tensioner	EN-8
Stopper	EN-8
Hydraulic cylinder	EN-8
Cylindrical ht. piece	EN-8

Assembled Hydraulic Fixture

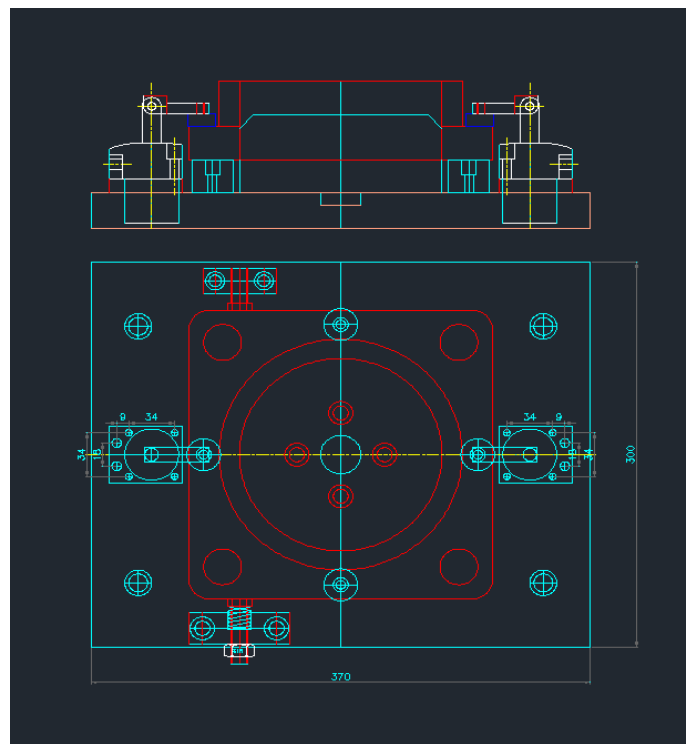


Fig. 6 assembled Hydraulic Fixture

V. RESULTS AND DISCUSSIONS

A. Construction: This fixture is made by Fabrication method in which body is made up from separate parts. In a fabricated construction, all the component parts can be completely machined before assembly. The construction is held together by screws and dowels. The screws serve only to hold the parts together with the dowels assuring accurate alignment.

Fabrication has following advantages:

- 1) Standard parts can be used to build up the body.
- 2) Fixture can be built up quickly by using standard parts.
- 3) A fabricated construction is easy to repair because disassembly is comparatively easy.

Table 2: **Results** of using hydraulic fixture instead of manual fixture is shown in table given below.

Sr. No	Parameters	Manual Fixture	Hydraulic Fixture
1	Loading/Unloading time	1 min	30 sec
2	Cycle time/job	3 min.30 sec.	2 min 30sec
3	Jobs/shift	110	130
4	Rejection % of 1 product	5%	1%
5	Productivity	Less Productivity	Productivity increased

C. Advantages

- 1) The major benefit of hydraulic work holding is enormous time saved in clamping & unclamping the components. It reduces cycle time hence manufacturing capacity increases & cost reduces.
- 2) In hydraulic fixture clamping forces are constant resulting in very precise positioning & clamping. This ensures identical processing procedures & guaranteed quality.
- 3) For every cycle, parts are clamped with the same clamping force & in the same location eliminating the variability in part deflection from clamping forces and improving process stability.
- 4) More parts will fit within machine envelope due to the high clamp forces generated with small hydraulic components hence get more productivity.
- 5) Eliminates human error due to assurance that every clamp will be actuated with every cycle, eliminating human error and missed steps. Also allows operators to be consistently more productive with less effort hence increase ergonomic efficiency.

VI. CONCLUSION

The proposed fixture will not only provides the repeatability and high productivity, but also offers a solution, which reduces work piece distortion due to clamping and machining forces. Implementation of this project eliminates the need of human operator for clamping of manifolds. It reduces the cycle time. It gives an economically feasible design. Also ensures accurate & efficient clamping of parts. The suggested system helps in achieving sophisticated, precise, reliable, safe as well as accurate production methods. The clamping systems are designed such that they withstand the huge retention forces applied from the machining operations onto the work piece. By using manual fixture production of manifold is insufficient in industries. Hence, hydraulic fixture is a good option to increase the production of manifold.

REFERENCES

- [1] Sridharakeshava K B, Ramesh Babu. K, “An Advanced Treatise on Jigs and Fixture Design” International Journal of Engineering Research & Technology (IJERT) ISSN: 2278-0181 Vol. 2 Issue 8, August – 2013.
- [2] Shailesh S Pachbhai and Laukik P Raut, “Design and development of Hydraulic Fixture for machining Hydraulic lift Housing” International Journal of Mechanical Engineering and Robotic Research ISSN 2278 – 0149 Vol. 3, No. 3, July, 2014.
- [3] N. P. Maniar, D. P. Vakharia, “ Design & Development of Fixture for CNC –Reviews, Practices & Future Directions” International Journal of Scientific & Engineering Research Volume 4, Issue 2, February-2013 ISSN 2229-5518.



- [4] Navya K.R., S. Pradeep, “Automation of Fixtures Using Hydraulic Power Pack for A Bogie Underframe” IOSR Journal of Mechanical and Civil Engineering e-ISSN: 2278-1684, p-ISSN: 2320-334X, Volume 10, Issue 1 (Nov. - Dec. 2013).
- [5] S.D.V.V.S.B.Reddy, P.Satish Reddy, V.Subrahmanyam, “Design And Analysis Of Machining (Hydraulic) Fixture For AVTEC Transmission Case Component” International Journal of Science Engineering and Advance Technology IJSEAT, Vol 2, Issue 7, July - 2014 ISSN 2321-6905.
- [6] Vektec, “Fundamental Technical Hydraulic Clamping information” Aug 2009 Rev D.
- [7]. Shrikant V Peshawar and Laukik P Raut(2013), “Design and Development of Fixture for Eccentric Shaft: A Review”, International Journal of Engineering Research and Applications (IJERA)ISSN: 2248-9622, Vol. 3, No. 1.
- [8]. Shrikant V Peshatwar and Laukik P Raut(2014), “Computer-Aided Fixture Design: A Review”, International Journal of Advanced Engineering Research and Technology, Vol. 2, No. 1, ISSN, pp. 2348-8190
- [9] Design, Development and Analysis of Hydraulic Fixture for machining Engine cylinder block on VMC Abhijeet Swami, Prof. G.E. Kondhalka
- [10] J Cecil (2008), “A Clamping Design Approach for Automated Fixture Design”, International Journal of Advance Manufacturing Technology, Vol. 18, pp.784-789.
- [11] Jose F Hurtado and Shreyes N Melkote(2001), “Effect of Fixture Design Variables on Fixture-Work piece Conformability and Static Stability”, 2001 IEEHASME International Conference on Advanced Intelligent Mechatronic Proceedings ,COW Italy.
- [12] Review Paper on Design Strategies for Manufacturing Fixtures as per Machine Operations Supriya A. Patil Dr. S. S. Goilkar Volume 2, Issue 3 Asian Journal of Convergence in Technology Issn No.:2350-1146, I.F-2.71.
- [13] Kiran Valandi, M. Vijaykumar ,Kishore Kumar S, Development, Fabrication and Analysis of Fixture, International journal of science technology management and research; 2014, Vol.3, Issue 4