



INTERNATIONAL JOURNAL FOR ENGINEERING APPLICATIONS AND TECHNOLOGY

DESIGN OF FIXTURE FOR ABUTMENT SUBASSEMBLY

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ABSTRACT

The automobile based industry Dura Automotive Systems whose products are Gear Shifter, Shifter Cable, Tire Carrier, Park Brake, Park Brake Cable have problem on Mahindra Shifter Cable line. The problem is related to Abutment Assembly of a line. Abutment is a part of shifter cable used for positioning and mounting of cable in vehicle. During assembly of abutment due to lack in skill of worker the part of abutment, rubber damper is misplaced. It results improper movement of abutment thus failure of shifter cable. Due to absent of rubber damper abutment possess linear displacement. Because of this major problem will be occur. There will be problem during shifting of gear in the vehicle. It leads to rejection of shifter cable in inspection by customer. This effect on reputation of an organisation in the global market. Therefore, this problem must be solved. So using this fact we are designing a fixture which checks whether a linear displacement is present or not. If the abutment possesses any linear displacement, then it is considering as NOT-OK part and if there is no linear displacement it is taken as OK part. It frequently reduces the complexity of a process, allowing for unskilled workers to perform it effectively. Fixtures also allow for a higher degree of operator safety by reducing the concentration and effort required to hold a piece steady. So checking fixtures are used and serve as one of the most important facility of mass production system. With the help of this fixture we can increase the accuracy and optimise the production.

Index Terms: - Abutment, Rubber Damper, NOT-OK part, OK part.

1. INTRODUCTION

Dura Automotive Systems (or Dura) is an independent designer and manufacturer of automotive components, including control systems, exterior systems and lightweight structural systems. Dura markets its automotive products to every North American, Asian and European Original Equipment Manufacturer (OEM) and many leading Tier 1 automotive suppliers. Dura is headquartered in Auburn Hills, Michigan, USA with more than 21,000 employees at 41 sites in 15 countries.

Dura was ranked in the 2006 Fortune 1000. Later that year, on October 30, 2006, Dura filed for chapter 11 bankruptcy protection. Final determination to delist

Dura's common stock and convertible trust preferred securities from NASDAQ was made November 13, 2006.

In December 2009, Dura Automotive Systems was acquired by Lynn Tilton through her New York-based private equity firm Patriarch Partners. In the deal, Dura absorbed Global Automotive Systems of suburban Detroit, also owned by Patriarch Partners, to form a parts supplier with global "sales

of \$1.6 billion and 10,800 employees in 39 manufacturing operations in 16 countries.

PRODUCTS MANUFACTURED:

1. Gear shifter cable
2. Gear shifter

3. Park Brake
4. Park brake cable
5. Tire carrier

During summer internship in DURA AUTO. PVT. Company, one of the members of our group found a problem on Mahindra Line. The problem was related to gear shifter cable. There was need of a fixture for detection of missing rubber damper in abutment sub-assembly. So we decided to design a fixture for detection of missing rubber damper.

A fixture is a work-holding or support device used in the manufacturing industry. Fixtures are used to securely locate (position in a specific location or orientation) and support the work, ensuring that all parts produced using the fixture will maintain conformity and interchangeability. Using a fixture improves the economy of production by allowing smooth operation and quick transition from part to part, reducing the requirement for skilled labour by simplifying how work pieces are mounted, and increasing conformity across a production run.

A fixture differs from a Jig in that when a fixture is used, the tool must move relative to the work piece; a jig moves the piece while the tool remains stationary. A 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 interchangeability in the finished parts. It also serves to reduce working time by allowing quick set-up, and by smoothing the transition from part to part. It frequently reduces the complexity of a process, allowing for unskilled workers to perform it and effectively transferring the skill of the tool maker to the unskilled worker. Fixtures also allow for a higher degree of operator safety by reducing the concentration and effort required to hold a piece steady. Economically speaking the most valuable function of a fixture is to reduce labour costs. Without a fixture, operating a machine or process may require two or more operators; using a fixture can eliminate one of the operators by securing the work piece. So checking fixtures are used and serve as one of the most important facility of mass production system.

1.1. Problem Statement

The gear shifter cable consists abutments, inner and outer conduits, grommet, sleeves, mass.

Problem was occurred in sub-assembly of abutment.



Fig-1: Abutment

During sub-assembly of abutment rubber damper may get miss by the worker and on further operation there was no Poka-yoke for detection of missing rubber damper. This results improper working of gear shifter cable in automobiles.

1.2 Objective

- A 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 interchangeability in the finished parts.
- It also serves to reduce working time by allowing quick set-up, and by smoothing the transition from part to part. It frequently reduces the complexity of a process, allowing for unskilled workers to perform it and effectively transferring the skill of the tool maker to the unskilled worker
- Fixtures also allow for a higher degree of operator safety by reducing the concentration and effort required to hold a piece steady.
- There is no need for skilful setting of work on tool. Jigs and fixtures makes possible to employ unskilled or semi-skilled machine operator to make savings in labour cost. Higher production, reduction in scrap, easy assembly and savings in

labour cost results in ultimate reduction in unit cost.

- For any manufacturing company maintain the quality of the product is main factor. That is it must be satisfied the customer requirements. To maintain the reputation of respective company in the market quality of product is necessary.

1.3 Scope

- Basically purpose of design of our fixture is to detect missing rubber damper. So it helps to check out which side of rubber damper is missing in abutment. That is with help of this fixture the worker is able to find out the odd one.
- If we find out the defective abutment before shifter cable assembly, we can reduce the cost of extra materials. We can minimize the risk, working time and worker potential.
- Means manufacturing company will provide good product to the customer. So it maintains reputation of respective company in the market. This helps to the company for future business in global market.

2. LITERATURE REVIEW

Previous efforts for fixture layout design were mainly concentrated on formulation of an objective function against definite constraints including ease with a workpiece can be loaded/unloaded, clamping and position stability, workpiece controlling capability in presence of external perturbations and uniqueness of its location. Asada and By [6] applied kinematical analysis to study the fixture layout problem. They build up a criterion to ensure the workpiece location and its loading as well as unloading capability on fixture layout. Ferreira et al. [7] proposed heuristic approaches for automatic construction of fixture configurations during ass operations and aimed at minimizing the deflection and distortion of workpiece caused by locating pins. Additionally, finite element analysis and non-linear optimization algorithms have also been utilized to optimize the support position [8] and for sheet metal assembly [9]. Hockenberger and De Meter [10] introduced a heuristic to identify the optimal position of locators and clamps by considering min-max loading criterion.

Abovementioned studies did not consider inevitable processing error(s) such as fault arbitrarily generated in fixture elements.

- Ceglarek and Prakash initiated works on diagnosis of fixture failures by adopting engineering models. However, their work was confined to single fixture, single fault assumption. Researchers extended the work to multiple faults, multiple fixture and optimal sensor distribution .
- Lack of competent optimization algorithm further exacerbates the optimization of fixture layout design in MSA. Kim and Ding used basic exchange algorithm (BEA) to identify the optimal design of fixture layout which was originally used in experimental design to resolve similar design problems. BEA becomes inhibitive approach in case of fixture layout design problem as satisfactory results are not obtained even after large computational time. Actually, no current method has potential to resolve the time complexity of above mentioned problem owing to computational complexity. This article focuses on developing an efficient algorithm that is capable of producing acceptable solution in a reasonable time. In their study, improved result was obtained in terms of computational time without significantly shifting the optimal value. Kim and Ding [5] presented a data mining method where small subset of design alternatives are selected and local optimization algorithm is adopted to identify the better design. Research has also been conducted for diagnosis of single fixture faults by using Principal Component Analysis (PCA). The focus of current work is to identify optimal design of fixture layout in MSA process, which has received relatively little attention in the literature.

3: PRINCIPLE OF OPERATION

Due to missing of the rubber damper, there is a linear displacement occurred in the abutment assembly. If the linear displacement occur on the side of insert over mould that means rubber damper is missing on this side and if same linear displacement occur on the side of guide tube it means rubber damper is missing in this side.

So using this fact we decide to design a fixture for

detecting the missing rubber damper.

3.1 Factors Considered For Designing Fixture

Some factors were given by the company regarding the design of fixture. These factors are basically dependent on their industry environment. The factors are as follows:

As the problem is occurring at the abutment sub-assembly, so we have to consider the factors which

After design the fixture, it should be plant just neighbour to the abutment sub-assembly machine. So we measured the area which is available at the line of abutment sub-assembly. In that measured area our fixture should be properly fit.

- Sometimes due to unskilled worker it may be chances that NOT-OK part could be selected. To reduce these mistakes our fixtures should be user-friendly. Means it should be easy to locate the abutment in the fixture.
- Accuracy is the main factor of any fixture. In our case the accuracy should be very high. None of any NOT-OK abutment could be get pass by our fixture. Therefore it is necessary to maintain high accuracy.
- It should be not costly. For that we are trying to supply the power from the abutment sub-assembly line which is require to run the fixture.

3.2 Force Acting on the Fixture

Different types of forces are going to act on the fixtures. First we should calculate the amount of force which can be able to do linear displacement of abutment.

For measuring of such forces digital force gauge is used. Using the Digital Force Gauge we were calculate the force required to displace the insert over mould and guide tube in the abutment. The operation to calculate the force is very easy using Digital Force Gauge. We have to just push the guide tube and insert Over mould with the help of Digital Force Gauge. As we push, the force will be shown on the screen of Digital Force Gauge. We can also change the measuring units of quantity. But we calculate the force in terms of newton.



Fig-2: Digital Force Gauge

For accurate measurement we took four-five readings of force required to cause the linear displacement of abutment. And from that we take a maximum force.

3.3 Selection of Cylinder

As comparison between different types of cylinders we conclude that Pneumatic cylinder is best choice for our fixture.

In market standard pneumatic cylinders are available with standard piston diameter. Now we have to calculate that which standard piston diameter cylinder is suitable for our fixture.

$$P = \frac{F}{A}$$

$$P = 2 \times 10^5, F = 20N$$

$$\therefore 2 \times 10^5 = \frac{20}{A}$$

$$\therefore A = \frac{20}{2 \times 10^5} \dots\dots\dots (A = \frac{\pi d^2}{4})$$

$$\therefore d = 11.28 \text{ mm}$$

From above calculation we required minimum 12 mm diameter piston cylinder. But in market standard pneumatic cylinders are available with standard piston diameter. So considering factor of safety we are going to select higher diameter than 12 mm. The standard diameter available in market are 12, 16, 20, 25, 32, 40, 50, 63, 80, 100, 125 mm. We will select 16 mm diameter piston cylinder.

3.4 SELECTION OF MATERIALS

In case of our fixture there are no major forces. Our fixture carrying weights of different components & force due to movement of cylinders. Therefore we taking EN8 material for designing of fixture due to following reasons:

- EN8 is a medium carbon steel usually supplied untreated.
- EN8 has good tensile strength.
- EN8 is a very popular grade and is readily machinable in any condition.
- It's cost less.

3.5 MANUFACTURING PROCESSES USED FOR DESIGNING OF FIXTURE

3.5.1 Wire cutting

The Wire Electric Discharge Machining (WEDM) is a variation of EDM and is commonly known as wire-cut EDM or wire cutting. In this process, a thin metallic wire is fed on-to the work piece, which is submerged in a tank of dielectric fluid such as deionized water. This process can also cut plates as thick as 300mm and is used for making punches, tools and dies from hard metals that are difficult to machine with other methods.

3.5.2 Drilling

Drilling is a cutting process that uses a drill bit to cut a hole of circular cross-section in solid materials. The drill bit is usually a rotary cutting tool, often multipoint. The bit is pressed against the workpiece and rotated at rates from hundreds to thousands of revolutions per minute.

3.5.3 Tapping

Taps and dies are tools used to create screw threads, which is called threading. Many are cutting tools; others are forming tools. A tap is used to cut or form the female portion of the mating pair (e.g., a nut). A die is used to cut or form the male portion of the mating pair (e.g., a bolt). The process of cutting or forming threads using a tap is called tapping.

3.5.4 Grinding

A grinding machine, often shortened to grinder, is any of various power tools or machine tools used for grinding, which is a type of machining using an abrasive

wheel as the cutting tool. Each grain of abrasive on the wheel's surface cuts a small chip from the workpiece via shear deformation.

3.5.5 Zinc Plating

Electrodeposition is a process, which uses an electrical current to reduce cations of a desired material from a solution and coat that material as a thin film onto a conductive substrate surface. In this case, zinc cations will be reduced and coat the steel substrates acting as a sacrificial coating to provide corrosion resistance. Three widely used industrial zinc plating processes will be examined, including acid chloride, alkaline cyanide, and alkaline non-cyanide. These processes will be discussed in terms of throwing power, hydrogen embrittlement, deposition mechanisms and salt spray testing. After the zinc plating line is operational, training methods must be documented to adhere to ISO 9001 quality level.

4. CONCLUSION

Thus we have concluded that, with this fixture we can easily detect the missing rubber damper in abutment. It is cheaper than any other alternative mechanism currently available to detect missing damper in abutment. This fixture is also user friendly.

It also serves to reduce working time by allowing quick set-up, and by smoothing the transition from part to part. It frequently reduces the complexity of a process, allowing for unskilled workers to perform it and effectively transferring the skill of the tool maker to the unskilled worker.

There is no need for skilful setting of work on tool. Jigs and fixtures makes possible to employ unskilled or semi-skilled machine operator to make savings in labour cost. Higher production, reduction in scrap, easy assembly and savings in labour cost results in ultimate reduction in unit cost.

The above advantages of fixture are perfectly matches with our requirement so we decided to design and manufacture the fixture.

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