International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 08 Issue: 05 | May 2021 www.irjet.net p-ISSN: 2395-0072

Mistake Proofing for Reverse Sleeve Yoke Outer Diameter Oversize

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Abstract – *The Automobile transmission system consists of Engine, Clutch, Gearbox, Propeller shaft, Differential and Axle. Propeller Shaft has reverse sleeve yoke which is assembled in gear box. Reverse sleeve yoke outer diameter is ground in grinding machine. If the outer diameter is oversize the assembly of propeller shaft is not possible at customer end. To avoid defective part reaching to customer, some mistake proofing arrangement is required, the mistake proofing arrangements is done on Press Machine.*

Key Words: **Poka Yoke[1], Reverse Sleeve Yoke[2], Propeller Shaft[3], Press Machine[4], Mistake Proofing[5]**

1.INTRODUCTION

The term poka-yoke was applied by Shigeo Shingo in the 1960s to industrial processes designed to prevent human errors. Shingo redesigned a process in which factory workers, while assembling a small switch, would often forget to insert the required spring under one of the switch buttons. In the redesigned process, the worker would perform the task in two steps, first preparing the two required springs and placing them in a placeholder, then inserting the springs from the placeholder into the switch. When a spring remained in the placeholder, the workers knew that they had forgotten to insert it and could correct the mistake effortlessly. Shingo distinguished between the concepts of inevitable human mistakes and defects in the production. Defects occur when the mistakes are allowed to reach the customer. The aim of poka-yoke is to design the process so that mistakes can be detected and corrected immediately, eliminating defects at the source. In today's competitive world any organization has to manufacture high quality, defect free products at optimum cost. The new culture of the total quality management, total productive management into the manufacturing as well as service sector gave birth to new ways to improve quality of products. By using various tools of TQM like KAIZEN, 6 sigma, JIT, JIDCO, POKA YOKE, FMS & etc. other technique. Organization is intended to develop quality culture.

In a very competitive world where same product is manufactured by hundreds of manufacturers, Quality of a product plays an important role. Hence to improve the quality of the product we implemented poka-yoke concept on production line. These arrangements are done on press machine, the actual flow process of production of reverse sleeve yoke is consists many operations like surface finishing, grinding, staking and so on. The staking is nearly the last operation in the production process in which the reverse sleeve yoke is attached with the dust cap which prevent contamination in the gear box. While implementing poka-yoke we installed many devices such as air gauge, proximity sensor, rejection bin, led light and indicator lights.

Detailed working of all the components involved are elaborated further in this paper.

1.1 PROBLEM STATEMENT

Due to outer diameter oversize of reverse sleeve yoke assembly is not possible, if assemble then there is oil leakage from propeller shaft.

1.2 COMPONENTS INVOLVED

1.Guide pin
2. Blinking light and Alarms
3. Limit Switches
4. Proximity switches(sensor)

2. LITERATURE REVIEW

D. Antoneli and D. Stadnicka in the paper titled "Classification and Efficiency Estimation of Mistake Proofing Solutions by Fuzzy Inference" published in the year 2016 showed that, how to find out the efficiency of solution and cost effectiveness. In order to select the best suitable solution for a given industrial problem, the solutions are rated and assessed on the basis of set of criteria. Some examples which are taken from real industrial case studies demonstrate the proposed Method. On production lines different kinds of solutions, in order to prevent nonconformities or to minimize the number of mistakes significantly, are implemented, assume that the P-Y is a solution developed in order to reduce the number of mistakes, or in order to eliminate the mistakes completely.

Table represent the types of p-y solutions.

Table 1: Classification of P-Y Solutions

Type	Function	Task	Goal
Technical Solutions	Preventive	Exclusion of mistakes	Prevention of mistakes
	Corrective	Stop the process in case of mistake	Preventing the forward flow of nonconforming products
	Informative and Preventive	Information concerning probability	Preventing mistakes
	Warning	Information on the mistake	Disclosing a place for improvement
Organizational Solutions	Informative	Information to avoid mistakes	Preventing mistakes
	Corrective	Information on what to do in case of a mistake	Preventing the reoccurrence of mistakes

Different criteria are used in the evaluation of its efficiency. Saurin (2012) Propose a framework of assessing P-Y Solutions. This method is fairly detailed an includes several evaluation criteria. In this paper industrial case studies are demonstrate the proposed method the studies are namely augmented reality to improve quality of spot welding, Products kitting system, Laser inspection of rolling bearing.

Che-Ani M.N., Sapien A.S., Azid I.A and Kamaruddin S, In the paper titled, "Solving Production Processes Disparity Issue Through Implementation of Poka-yoke Concept" published in the year 2017 showed that how to apply pareto and ishikawa diagram on actual industrial process. In this paper case study company is an automotive assembly process which involves final assembly of the vehicle manufacturing. The layout of the production shop floor consists of single production line and divided into four main section which are trim, chassis, final assembly and final inspection. The process is sequential, in batch, multipath and asynchronous each process is managed by different group of management and it influences the reject rate due to disparity issue such as miscommunication. The reject rate has been monitored within a month in a final inspection process and the data has been analyzed, and a solution to reduce the part defects needs to be found.

E.A. Attia, K. Khader, O. Nadab in the paper titled "Mistake Proofing Cam Mechanism Through Six Sigma Process: Case Study on Clothes Printing Machines," published in the year help us to learn implementation of six sigma on industrial problem. The six sigma DMADV approach has been implemented to improve the process performance. Modifications of the current printing machine design using mistake proofing principles that have been proposed to prevent or diminish the occurrence of defect. Geneva prototype is manufactured to be used in printing machine instead of hydraulic and pneumatic systems. A prototype of cams mechanism is used for testing and validate the idea. Mistake proofing are applied to t-shirts screen printing machine. Generally, screen printing machines use hydraulic and pneumatic system attached to a rotary table as indexing and timing arrangement. Generally, screen printing t-shirts can be considered as a mass production method of the garment by which, an amount of finished garment is printed with the desired design using several types of ink. Hence, this paper is dealing with solving the printing machines problem through implementation of the DMADV process.

Meet Doshi, Raj Bhanushali in the paper titled "Development of Machine Vision-Best Mistake Proofing System for Automotive Industry Automation" Published in the year 2019 tells us about automatic in-line inspection on actual flow process. In this paper author discussed how vision system aids in developing automated mistake proofing solutions. These solutions will be targeted for manual assembling of product in automobile industry.

3. CONSTRUCTION

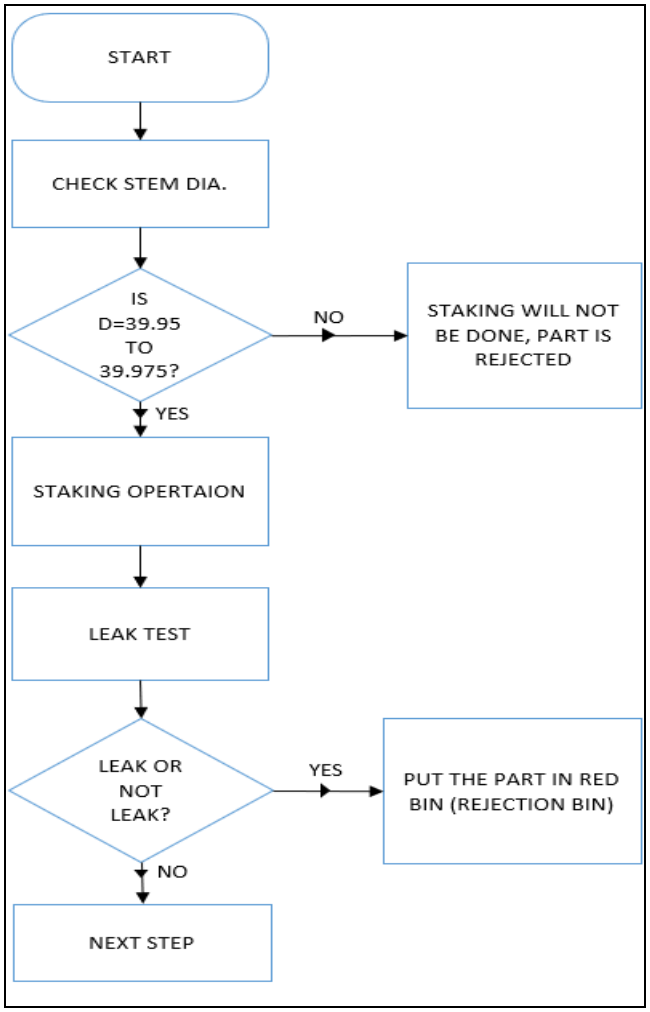
In implementing poka-yoke some arrangements are done on press machine to stop the defective part reaching customer. In this stage inspection of part along with the staking operation is also done. Setup consists of following components:

1. Air Gauge
2. LED Panel
3. Proximity Sensor
4. Leak Test Setup
5. Rejection Bin

4. WORKING

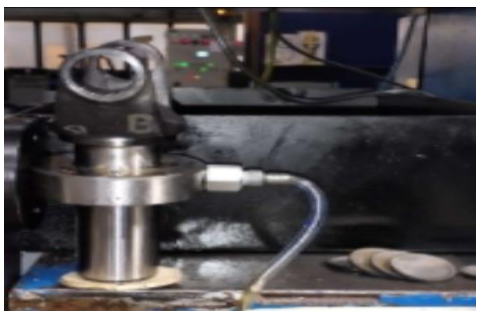
After surface finishing and grinding operation, the reverse sleeve yoke is sent for staking operation on press machine. Initially, the stem diameter of reverse sleeve yoke is measured with the help of air gauge which is of type ring gauge and diameter is displayed on LED panel the range of diameter is in between 39.95 to 39.97, if the diameter is within range the staking operation is done otherwise the part is rejected and should be put in rejection bill, if diameter is within the range, then Staking operation is done. After this operation the part is then fixed on leak test setup where leakage in fit is checked, the pressure of 3.75 kg/cm^2 is built up. If the part found to be leaked then it will be put in rejection bin and part is rejected, no further operation on that part is done the part will become scrap, if no leak is found then the part is sent for further procedure. The flow chart shows a quick overview of the whole process.

Fig.1: Flow chart



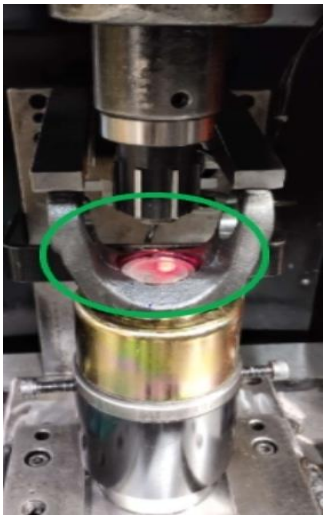
Air Gauge: It is used to measure the stem diameter of reverse sleeve yoke it is of ring type, which measures the diameter with the help of air and then displayed on LED panel so that operator can see the value easily.

Fig.2: Air Gauge



Staking Operation: It is an operation of joining two components by press fit, the reverse sleeve yoke and dust cap is assembled together in this stage.

Fig.3: Staking Operation



Proximity Sensor: This is mounted on press machine near the staking fixture. It is inductive type of sensor which senses the metal component. If the metal component comes within 8mm range then it senses the component and send signal to machine and then press machine starts.

Fig.4: Proximity Sensor

4.Leak Test Setup: After staking operation the component is placed into leak test setup and air pressure is built up upto 3.75 kg/cm^2, which ensures proper plug staking between reverse sleeve yoke and dust cap.

Fig.5: Leak Test Setup

5.Rejection Bin: It is a box of rectangular cross section which is red in color where rejected component is placed which consists of limit sensors, if the part is not kept in rejection bin then subsequent operation will not start.

Fig,6: Rejection Bin

5. TIME ANALYSIS

In this section, the time saving in the production process before and after the implementation of mistake proofing solution.

Table 2: Time Analysis per part

Time	
Before poka-yoke	After poka-yoke
120 sec	25sec

Before implementation of mistake proofing solution, the diameter of reverse sleeve yoke is checked by snap gauge which nearly consume 120 seconds of valuable production time, which is now reduced to 25 seconds per part.

5. CONCLUSION

The purpose of implementing Poka-yoke is to minimize or at best eliminate human errors during the manufacturing procedure, so that a defect product of low quality does not reach customers hands. The main idea behind this system is to be able to prevent any causes that might lead to mistakes in the operation process by constant monitoring all production stages. This requires synergy with workers, that can apply corrective measures when Poka-yoke identifies the possibility of defects.

ACKNOWLEDGEMENT

Authors wish to acknowledge Mr. Nitin Bhopale and Mr. Vivek Burhade for providing insight and expertise that greatly assisted the research. Authors also like to thank Mr. Satish Suryawanshi for valuable guidance during research.

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