

POKA-YOKE: MISTAKE PROOFING TO ACHIEVE ZERO DEFECTS

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ABSTRACT

Advanced manufacturing is the use of innovative technology to improve products or processes. Now-a-days POKA YOKE'S made by new technologies are used for mistake proofing to achieve ' ZERO DEFECT '. Poka Yoke focuses on eliminating the defects of human origination by reducing the opportunity for defects.

Naturally human beings are not mistake proofed, therefore we can't eliminate all the mistakes done by human beings. But organization can avoid these mistakes from reaching to the customer, which is known as a defect in this case. Japanese manufacturing engineer Shigeo Shingo develops the quality assurance technique Poka Yoke. The aim of Poka Yoke is to eliminate defects in a product by preventing or correcting mistakes as early as possible. A Poka Yoke is done by using a method that uses sensor or other devices for catching errors that may pass by human beings or operators. Shigeo Shingo defines Poka Yoke as: Poka – "Inadvertent Mistake That Anyone Can Make" [2] and Yoke – "To Prevent or Proof" [1]. Poka -Yoke performs two key operations of ZDQ (Zero Defect Quality) i.e. identifying the defect immediately (Point of Origin Inspection) & quick feedback for corrective action. Poka-yoke detects an error, gives a warning, and can shut down the process.

This paper describes the solution on customer complaint of failure of brake in the car due to wrong machining in the TMC (Tandem Master Cylinder). The root cause is detected by using systematic 8-D method. To overcome this problem we have made a Poka Yoke using laser sensor.

INTRODUCTION

Today there is more competition in industrial world. To remain on good position in this big competition, any organization has to manufacture high quality, defect free products at optimum cost. This gave birth to new ways to improve quality of products. By using various tools of TQM like KAIZEN, 6 sigma, JIT, JIDCO, and POKA YOKE etc.

Eliminating mistake is necessary. But meanwhile it is very important to find out the causes of mistakes. Some time some systems lead people to do mistakes. So many data passing processes and other things makes the systems complicated [3].

People cannot do same work at every time like a robot, because of physical and mental limitations. Therefore there are more chances of doing mistakes by humans. But it is not their fault. It happens due to complicated and poorly-designed system or process requiring a great deal of attention [3].

A poka-yoke device or solution is any mechanism or idea that either avoids the mistake from being made or makes the mistake easily detected at a glance. The ability to find mistakes at a glance is important because, as Shingo states, "The causes of defects lie in worker errors, and defects are the results of neglecting those errors. It follows that mistakes will not turn into defects if worker errors are discovered and eliminated beforehand"[Shingo 1986, p.50].[4] He also adds to this that "Defects arise because errors are made; the two have a cause-and-effect relationship. ... Yet errors will not turn into defects if feedback and action take place at the error stage"[Shingo, 1986, p. 82] [4].

Let's discuss some example of Poka Yoke. To avoid the running of machinery at low oil levels, which

causing friction in machinery, we can do Poka Yoke by using automatic stoppage of machinery when oil levels go down. So people will not operate machinery with lower oil levels. Let see one more example of best Poka yoke in computer. Computer has every plug with exactly matching socket. Therefore no other device can be plugged into this. So there is zero chance of mistake.

This paper also explains the Poka Yoke done on customer complaint of failure of brake in the car due to wrong machining in the TMC (Tandem Master Cylinder) by using sensors.

CUSTOMER COMPLAINT:

Failure of brake due to wrong machining in the TMC (Tandem Master Cylinder).

PROBLEM IDENTIFICATION:

Problem identification is done by systematic 8-D method.

WHAT IS 8-D ?

The 8D method is used for eliminating problems and therefore preventing the recurrence by Lasting and systematic processing of internal and external problems by locating and eliminating the technical and systemic root cause.

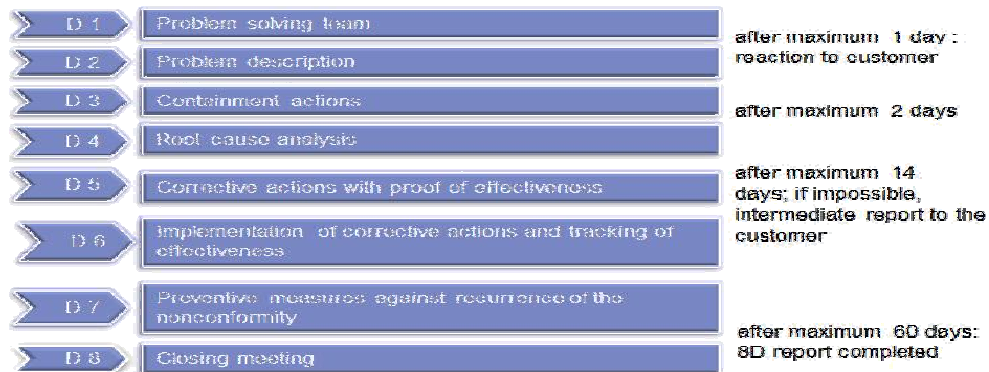


Figure 1 : Explanation of 8D method

B. CONCLUSION OF 8D:

As per this standard procedure the 8D team concludes that the root cause of this problem is wrong machining in TMC which is due to human error.

DATA COLLECTION:

As per our analysis we found that every month there are 25 - 30 jobs (approx.) were found on that line having wrong machining. Which are rejected and scrapped according to the procedure as 100 % inspection is done on that line.

Following graph shows the quantity of rejected/scrapped jobs due to wrong machining:

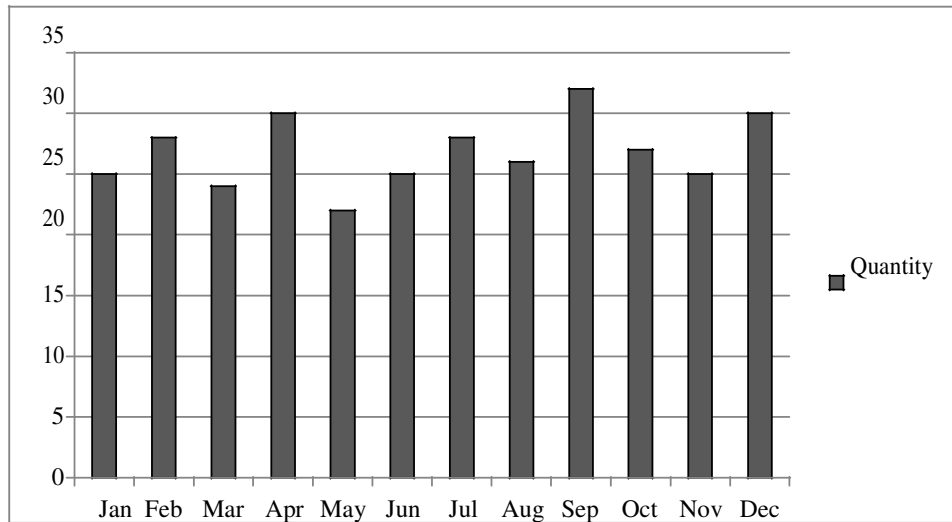


Figure 2 : Graphical representation of rejection quantity

ANALYSIS:

From above graph we came to know that there are approx. 25-30 jobs rejected/scrapped every month.
 From above data collection we analyzed that:

1. Cost of casting (raw material) is waste.
2. Cost of machining is waste.
3. Time and human effort is waste.
4. We are not achieving 'Zero Defect'. For a single job:
 1. Cost of casting = 150 Rs. (approx.)
 2. Cost of machining = 350 Rs. (approx.)
 3. Total cost is 500 Rs.(approx.)

Cost of a total jobs scrapped per year (25 per month) on a single machine = 500Rs. X 300 jobs = 1,50,000 Rs.(approx.)

1-10-100 RULE:

By this rule the cost for solve the defect is multiplies 10 times step by step;

1. At station/ machine we found defect in the job then the cost of machined job is only waste.
2. Suppose at assembly station we found defect in the job then the cost of machined job and the cost for assembly is waste. Which is approx 10 times the defective job found at machining.
3. If customer found defect in the job then the cost of machined job, cost for assembly and the cost of logistic is waste. Which is approx 100 times the defective job found at machining.

Due to this we have to minimize the defects or errors as early as possible. For that we have to implement proper poka yokes at particular stations where chances of errors are there due to mass production.

IMPLEMENTATION AND DEVELOPMENT OF POKA YOKE :

To achieve a ' Zero Defect ' we gives an idea of implementing a poka yoke using sensor on that particular

machine where chances of wrong machining is there which avoid a mixing of different types of casting on that line. Hence wrong machining is eliminated and the zero defects are easily achieved for that line/machine.

A. HOW POKA YOKE WORKS?

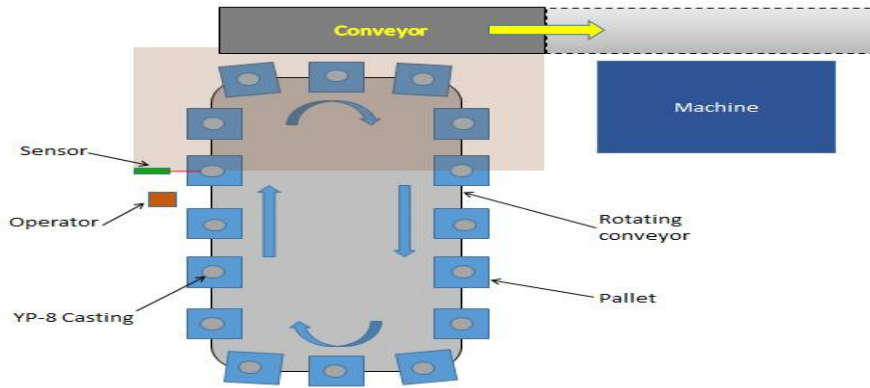


Figure 3 : Advance layout of EMAG machine

Above figure shows advanced layout of EMAG machine. Initially, operator places the casting of YP-8 over the pallet of the rotating conveyor. Then conveyor moves forward and pallet stops in front of the sensor. Sensor senses the face of the rib of YP-8 casting over the delivery ports which is at a distance of 100 mm from the sensor. As soon as the sensor senses the face of the rib at a distance of 100 mm it allows the casting to move forward. The robotic arm lifts the casting from the pallet and places it over the sliding conveyor. The sliding conveyor conveys the casting to deliver it to the machine for the machining process to be carried out. Machined component/job is reverted back to the sliding conveyor which places it back to the empty pallet on the rotating conveyor.

If in case, any other casting is placed on pallet by the operator instead of YP-8, the sensor will not sense the face of rib at 100 mm. This is due to the variation in the dimensions of the different castings.

To make things simpler, only the rib of the YP-8 casting excluding all the other types of castings, is kept at a distance of 100 mm. Rest all the rib of other castings are at more distance than 100 mm. Thus, it is clear that the sensor will sense the face of the rib of the casting only at 100 mm, which is of only YP-8 casting.

If any casting, other than YP-8, comes in front of the sensor, the sensor gives an alarm and the rotating conveyor will stop until the operator replaces the wrong casting with YP-8 casting.

This is illustrated in the figure below-

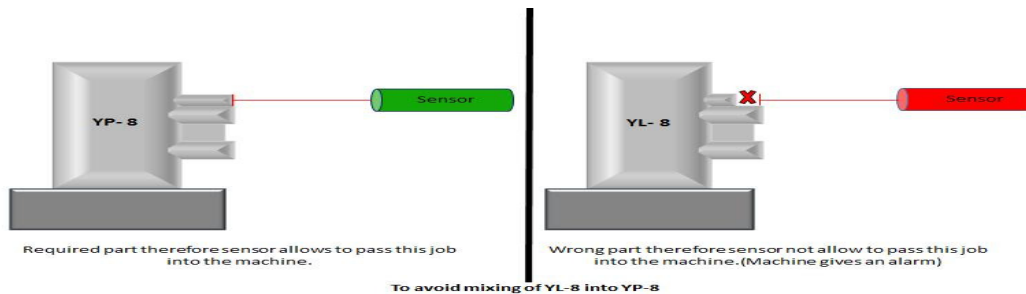


Figure 4 : Illustration of sensor working

This is the entire concept which was proposed by us. The practical trial was also done by us to verify whether the proposed concept is acceptable or not.



Figure 5 : Trial for YP-8 casting.



Figure 6 : Trial for YL-8 casting.

Figure 5 shows that the sensor senses the face of the rib of YP-8 casting and the output is shown by the “TURN ON” condition of the LED. This concludes that the YP-8 casting is present in front of the sensor and it allows the casting to pass forward for the machining.

Figure 6 shows that the sensor does not sense the face of the rib of YL-8 casting and the output is shown by the “TURN OFF” condition of the LED. This concludes that the YP-8 casting is not present in front of the sensor and it does not allow the casting to pass forward for the machining.

RESULT

If YP-8 casting is present in front of the sensor, then it allows the casting to pass forward for the machining. If any casting, other than YP-8, is present in front of the sensor, the sensor gives an alarm and the rotating conveyor will stop until the operator replaces the wrong casting with YP-8 casting.

CONCLUSION

Successful poka yoke results in increased productivity with minimum waste (waste due to rework, scrap) because we are sure about the quality of product, as mistakes are blocked at source itself. By using this poka yoke we have also increased the productivity with minimum waste and zero defect position. This poka yoke has following benefits:

- Best Quality level is achieved.
- Zero defect level is achieved.
- And most important, customer satisfaction also increased

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