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Implementation of POKA-YOKE Technique in Frame Body K32: A Case Study

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ABSTRACT

In this paper, our work focuses on the Poka-Yoke eliminating the defects of human origination by reducing the opportunity for defects. In the manufacturing industry Poka- Yoke method has become an important approach in order to produce quality products. Poka-yoke is providing a simple, robust and painless way for us to detect defects early in our localization efforts. Rejection of manufactured parts at various stages of manufacturing cannot be tolerated now days in production scenario due to tough competition worldwide. All manufacturing industries are moving in the direction of zero defect production. To implement this, the first and most important thing which is being done by the manufacturing industries is to prevent the error or completely eliminate the error with the application of some proven techniques used to solve the problem founding in frame body K32.

Key Words: Quality management, Mistake proofing; Poka-Yoke method; PDCA cycle

INTRODUCTION

In this highly competitive world, the desire and expectation for high-quality and reliable goods are growing on a daily basis. Consumers now have access to products of higher design, quality and functionality at lower prices than were previously possible. Quality becomes the dominant issues in the market place where customers make their buying decisions based on product quality; sometimes they can even pay more for what they consider as high quality product. Today there is more competition in industrial world. 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" [1]** and Yoke – "To Prevent or Proof**" [2].** 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 shuts down the process. 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**(Shigeo [1]).** 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**"(Shigeo [1].** Poka-Yoke allows process to run smoothly as they are fail-safe solution. It is the concentration on removing the causes of defects that is important. The inspection process is a backstop.The possibility of implementing the Poka-Yoke as a factor of improving operation in the process of the modernizations companies.

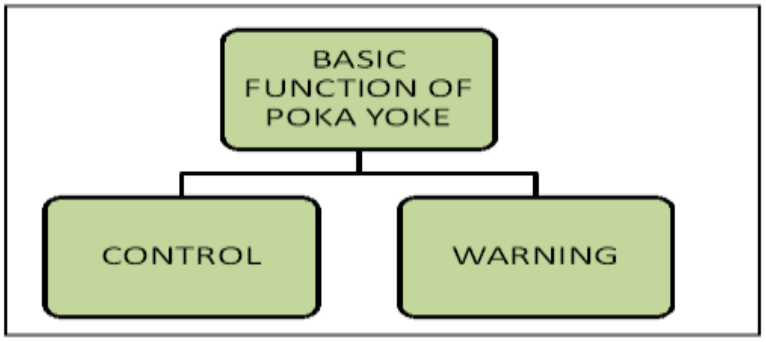

Figure 1: Function of Poka Yoke[9].

LITERATURE REVIEW

Dr. Shingo's[1] study explains the philosophy behind the Toyota Production System, provides additional information where required, criticizes weaknesses, gives credit where it is due, and highlight the system's important aspects. Shingo has developed the following conclusions from his study: ÿ Elimination of the waste of over-production cannot be achieved without SMED (single minute exchange of die) ÿ Shortened cycle times demand small lot production (SMED is crucial here as well) ÿ SMED must be achieved if we want to be able to respond to changes in consumer demand While Dr. Shingo was developing SMED, Mr. Ohno, as the executive managing director of Toyota, was realizing that there was a close connection between the principle aspects of the Toyota Production System and the SMED system..

Grout, John R. [2]: Poka-yoke (pronounced "POH-kah YOH-kay").Poka-yoke is a quality assurance technique developed by Japanese manufacturing engineer Shigeo Shingo. The aim of poka-yoke is to eliminate defects in a product by preventing or correcting mistakes as early as possible.

M. Dudek-Burlikowska, D. Szewieczek [3]: A new approach for the implementation of quality philosophy Zero Quality Defects with usage of the Poka-Yoke method in the polish organization has been presented. The possibility of usage of mistake proofing device is connected with monitoring and improvement of operations in the process. At the present time the organizations should implement quality tools, techniques, methods which support the prevention strategy and should pay attention to improving each element and operations in the process. Generally activity aim at prevent defects has been described. The Poka-Yoke method of preventing errors by putting limits on how operation can be performed in order to force the correct completion of the operation has been presented.

Navin Laxmanrao Potey [4]: Pokayoke is a technique for avoiding simple human error in the workplace also known as mistake-proofing, goof proofing. Poka-Yoke is simply a system designed to prevent inadvertent errors made by workers performing a process ..

Stefan Schmidt [5]: Preventive methods are seldom used in logistics although there is increasing awareness of their potential. He presents two examples of preventive methods currently in use, Poka- Yoke and FMEA(Failure Mode and effect Analysis).

Hemant L. Jadhav, R. Urgunde [6]: 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.

J Haddou, H.A.; P. Zarate [7]: Brainstorming helps a group create as many ideas as possible in as short a time as possible. Typically, brainstorming should only take about 5 to 10 minutes to generate 25 or 30 ideas.

Pratik D. Tak, Shravan S. Wagh [8]: Poka-yoke is a concept in total quality management which is related to restricting errors at source itself. It deals with "fail-safing" or "mistake-proofing". A poka-yoke is any idea generation or mechanism development in a total productive management process that helps operator to avoid (yokeru) mistakes (poka). The concept was generated, and developed by Shigeo Shingo for the Toyota Production System.

Yash Dave, Dr. Nagendra Sohani [9]: Rejection of manufactured parts at various stages of manufacturing cannot be tolerated now days in production scenario due to tough competition worldwide. All manufacturing industries are moving in the direction of zero defect production. To implement this, the first and most important thing which is being done by the manufacturing industries is to prevent the error or completely eliminate the error with the application of some proven techniques.

Sushant S. Shrigadi, Shivalee P. Pol , Prof. Anand K. Joshi [10]: Advanced manufacturing is the use of innovative technology to improve products or processes. Now-adays 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.

METHODOLOGY OF POKA YOKE

Steps to implement poka yoke[3].

1) Identify Problem
2) Observation at workstation

3) Brainstorming for idea
4) Select best idea
5) Implementation Plan & Implement
6) Monitor and sign off.

Once top management decides to implement TPM culture in organization then to compensate for defect free products successfully one should follow the following methodology .

CASE STUDY: FRAME BODY K32

1 Identify Problem

In this stage the complaints coming from the customers (Both internal and external customer) are collected. The principle of standard is determined by considering various criteria's like number of complaints from the customer, the quantity of defects detected by quality control, materiality defects (their impact on the customer, costs, implemented process) and then data is collected broadly. As per analysis results of the collected data company plans for developing poka yoke system for the selected problem. In this way in first stage the problem is selected. Here Pin pointing problems are selected:

1. During fine boring of frame body, there is a mismatch between axis of Tool & rough boring centre axisor frequency of tool wearing also more.
2. During Gauging in most of parts Grip rear position found NG. Mostly Grip rear position found NG due careless nature of welder on line. Welder assemble left Grip brkt on right side & right side on left one
3. During gauging other model Rear fender found in K32 frame Body which increase rejection ratio.
4. Fuel tank assembly Brkt CD found NG due to lot of part NG at Customer end.

2 Observation At Work Stations

In this step the actual on site study of the problem is carried out. The causes behind the problem are sort out by using Quality control tool (Pareto Diagram, Cause & Effect Diagram, Histogram, Control Charts, Scatter Diagrams, Graphs, Check Sheets).The causes may be related to man, machine, material or method accordingly the complete sorting is carried out. These problem are founds in workstation during fine boring of frame body, there is a mismatch between axis of Tool & rough boring centre axisor frequency of tool wearing also more. During Gauging in most of parts Grip rear position found NG. Mostly Grip rear position found NG due careless nature of welder on line. Welder assemble left Grip brkt on right side & right side on left oneDuring gauging other model Rear fender found in K32 frame Body which increase rejection ratio.Fuel tank assembly Brkt CD found NG due to lot of part NG at Customer end.

3 Brainstorming For Idea

This is a technique to capture creativity and skills of employee's .In brainstorming session the problem under study is put forward to committee. In manufacturing of Frame body mostly problem are found in various category such as Head ID found Unclean & tool wearing ratio more, Grip position found NG and Other model rear fender weld in K32 model, and Fuel tank mounting CD found NG.Then all members study problem and give various solutions to avoid that defect. As each person has one uniqueness this step concludes with various alternative solutions for

4 Select Best Ideas

After getting various alternative solutions it is time to select best one out of all collected solutions. Criteria for selection may be cost, time required, changes in existing system, opportunity to develop new solutions, simplicity in operation etc. By referring all selection criteria's committee concludes With one best solution is POKA YOKA.

5 Implementation Plan And Implementation

This step is concerned with implementation planning. It deals with material requirement, processing the material and finally manufactured mechanism is implemented at actual working site. In manufacturing of Frame body mostly problem are Head ID found Unclean & tool wearing ratio more, Grip position found NG and Other model rear fender weld in K32 model, and Fuel tank mounting CD found NG. By referring all selection criteria's committee concludes With one best solution is POKA YOKA which gives implement in all process with less cost and with less time consuming. In this step the actual on site study of the problem is carried out. The causes behind the problem are sort out by using Quality control tool .The causes may be related to man, machine, material or method accordingly the complete sorting is carried out.

PIN POINTING PROBLEMS

First of all we find potential cause for rejection and rework on frame body line by actual gemba and decide level of problems.

Table 1 Pin pointing problems.

Sl.No.	Potential Cause	Actual at Gemba	Judgement
1	Head ID found Unclean & tool wearing ratio more	During fine boring ID remains Unclean	⊙
2	Grip position found NG	No provision for preventing rotation of part	⊙
3	Other model rear fender weld in K32 model	No provision for preventing other model part assembly	⊙
4	Fuel tank mounting CD found NG	No Checking provision for CD	⊙

⊙ - Strong Relationship, O - Medium Relationship , □ - Weak/No Relationship

Potential Cause 1 Problem

During fine boring of frame body, there is a mismatch between axis of Tool & rough boring centre axisor frequency of tool wearing also more. Due to which after fine boring ovelty occurs on inner dia. Which results fit functional failure of Assembly with Front Fork Comp.? For rework Gusset head pipe assembly has to be removed.

Table 2: Potential Cause

Observation	Depth of Cut (in mm)	Tool Wear (in mm)
1	2.1	0.035
2	4.2	0.041
3	1.5	0.031
4	1.8	0.027
5	2.3	0.033
6	3.8	0.045
7	2.6	0.038
8	4.3	0.047
9	3.4	0.04
10	4.5	0.058
11	2.6	0.039
12	5.2	0.056
13	4.1	0.048
14	3	0.037
15	2.2	0.028
16	4.6	0.057
17	5.6	0.073
18	4.7	0.064
19	1.9	0.03
20	2.4	0.029
21	3.2	0.039
22	3.4	0.038

23	2.8	0.04
24	2.2	0.031
25	2	0.033
26	2.9	0.035
27	3	0.032
28	3.6	0.038
29	1.9	0.032
30	5.1	0.052
31	4.7	0.05
32	5.2	0.058

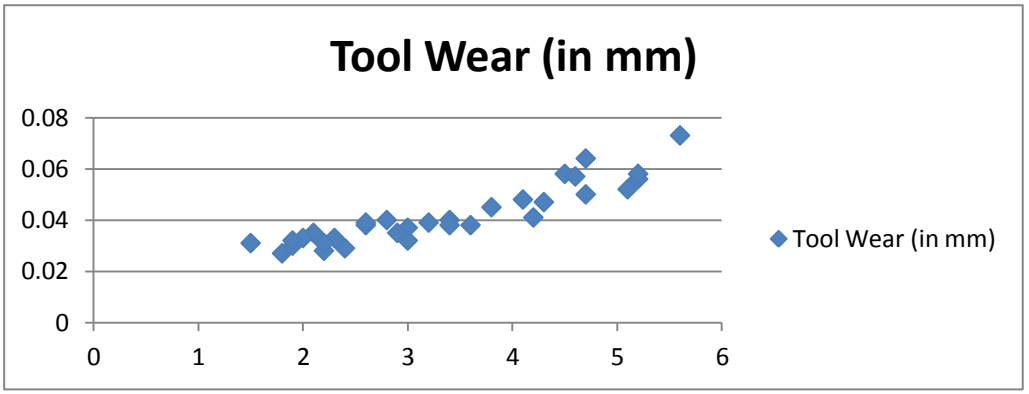

Figure 2 Shown tool wearing with help of scatter graph.

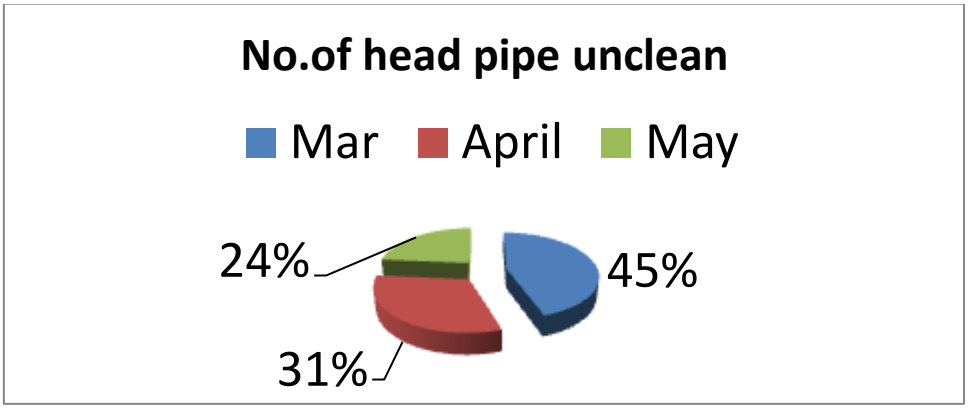

Figure 3 Shown rejection at fine boring.

Countermeasure

Gusset weld before fine boring to prevent ovelty occurs during fine boring .

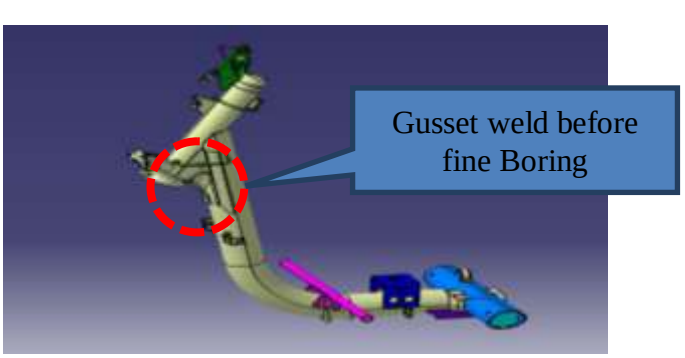

Figure 4 Gusset weld before fine boring to prevent ovelty occurs during fine boring and Brainstorming.

IMPLEMENTATION OF POKE YOKE

For prevent gusset miss during fine boring Proxy sensor mount on fine boring machine if gusset miss fine boring spindle not move forward due to which rework & rejection ratio zero regarding fine boring. And tool wearing out problem also solve.

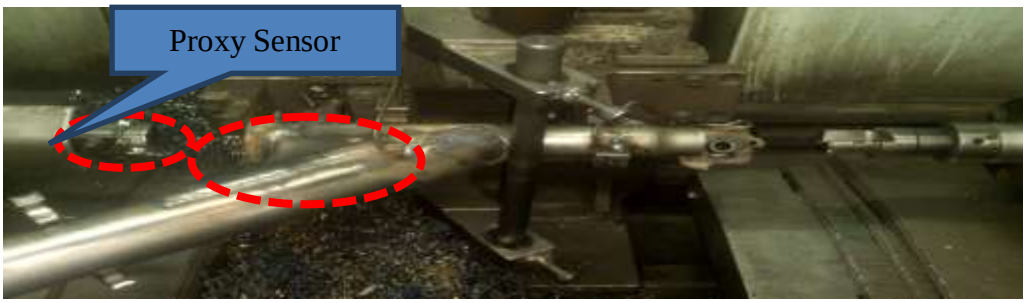

Figure 5 Fine boring Proxy sensor mount on fine boring machine.

Potential Cause 2

During Gauging in most of parts Grip rear position found NG. Mostly Grip rear position found NG due careless nature of welder on line. Welder assemble left Grip brkt on right side & right side on left one.

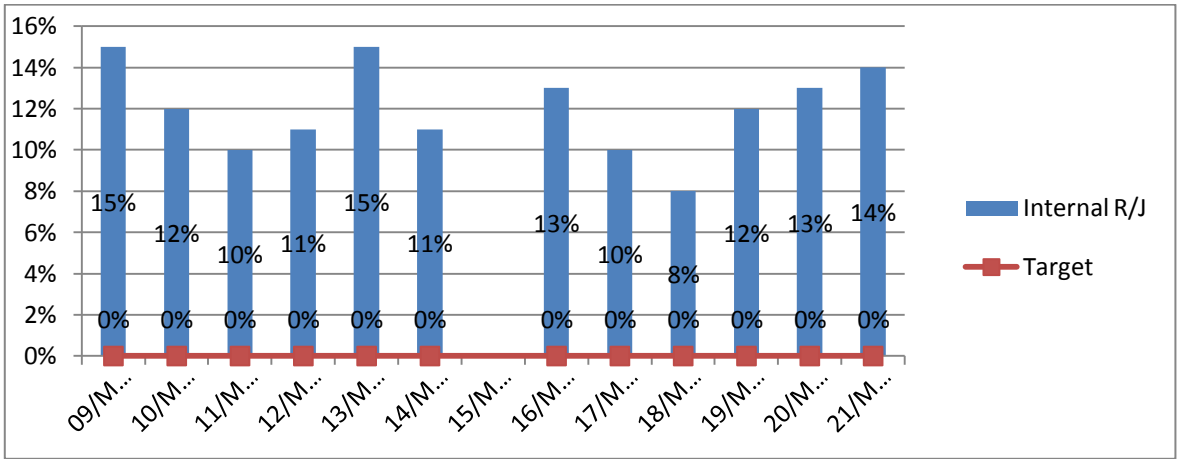

Figure 6 Shown Internal rejection regarding grip rear position.

Rout Cause

No provision provide regarding Interchange of Grip Brkt.

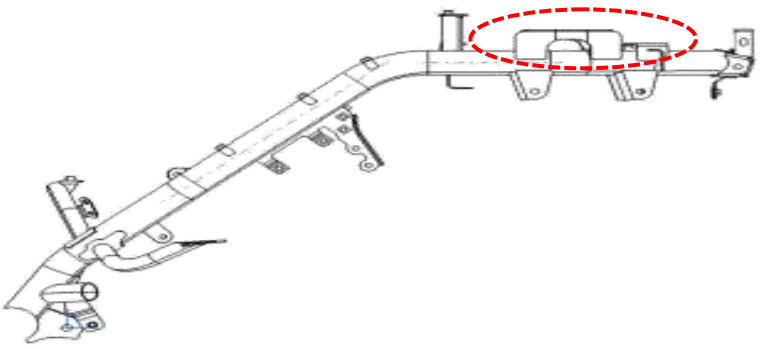

Figure 7 Show grip rear Brkt in frame body.

Countermeasure

Grip rear brkt CD guide in welding fixture for maintaining dim in Frame Body.

Figure 8 Shown grip Brkt CD Guide for maintaining Dim and Brainstorming .

Implementation of Poke Yoke

For preventing interchange of GripBrkt Complete profile guide with Dowel and profile block. Now welder can't weld right side part on left or left side on right.

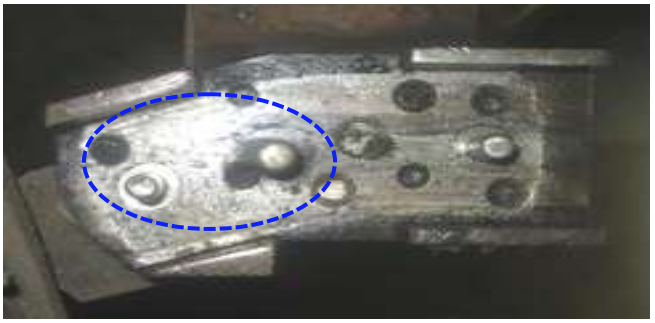

Figure 9 Grip Brkt.

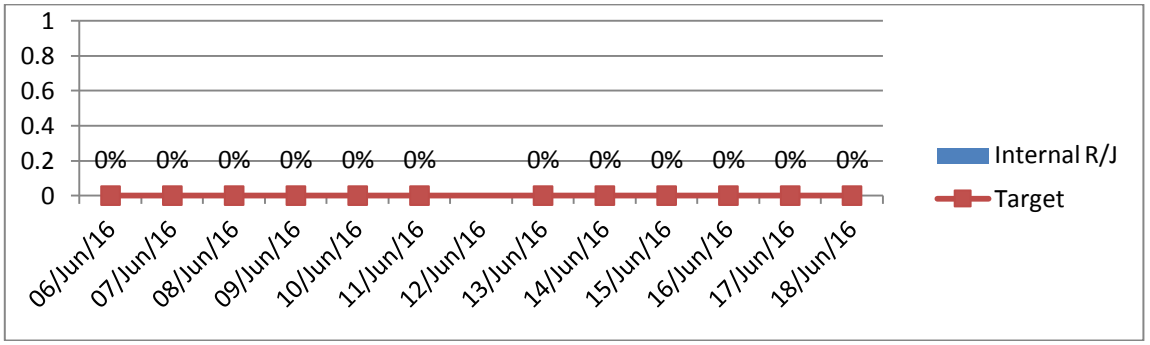

Figure 10 Shown rejection Ratio zero after implement poke yoke.

Potential Cause 3

During gauging other model Rear fender found in K32 frame Body which increase rejection ratio.

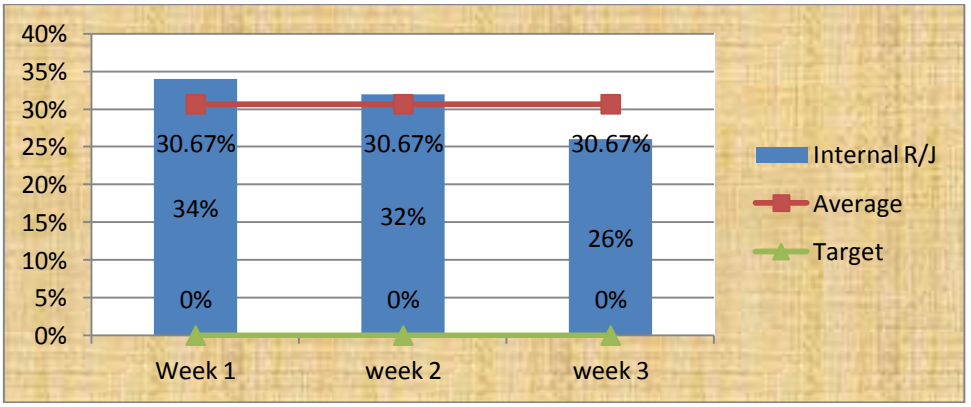

Figure 11 Shown weekly rejection due to Rear fender only.

Rout Cause

No provision provide for preventing other model rear fender.

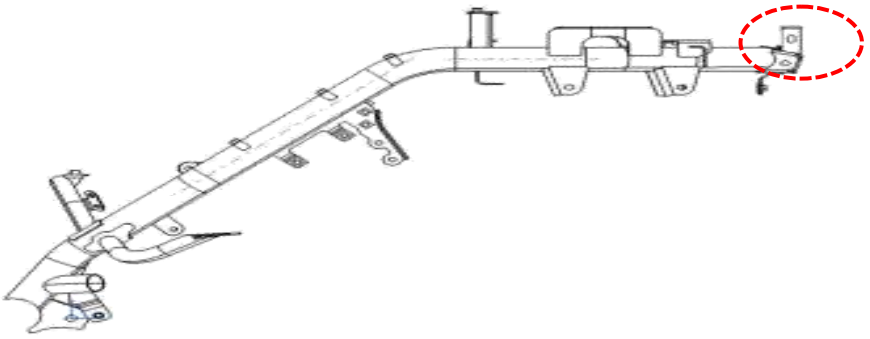

Figure 12 Show Rear fender in frame body.

Implementation Of Poke Yoke

L shape slider provided in welding fixture for preventing other model part assembles with K32 model. This poke yoke awards as best poke yoke at frame body line

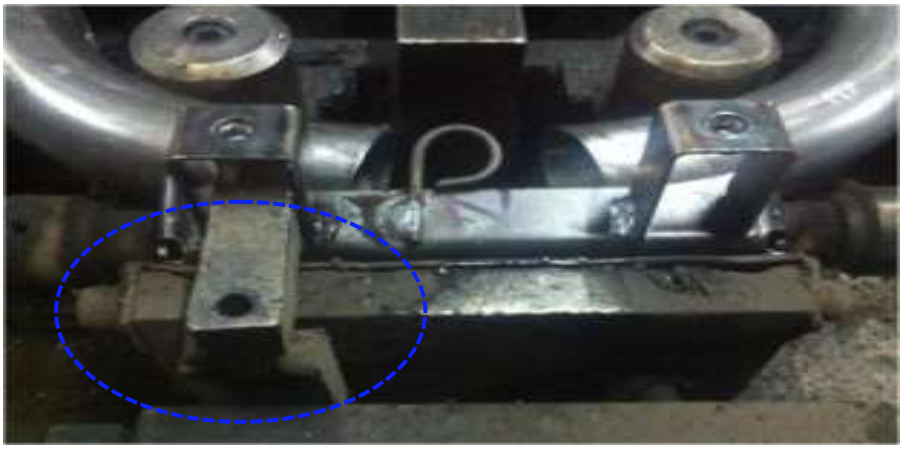

Figure 13 Shown L shape slider for assembly rear fender.

Potential Cause 4

Fuel tank assembly Brkt CD found NG due to lot of part NG at Customer end.

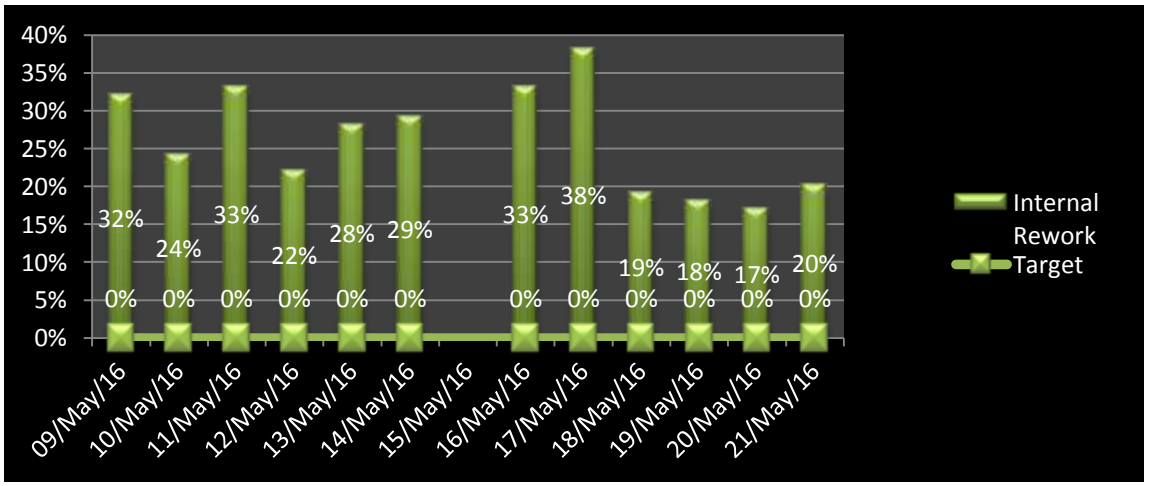

Figure 14 Shown rework due to CD NG.

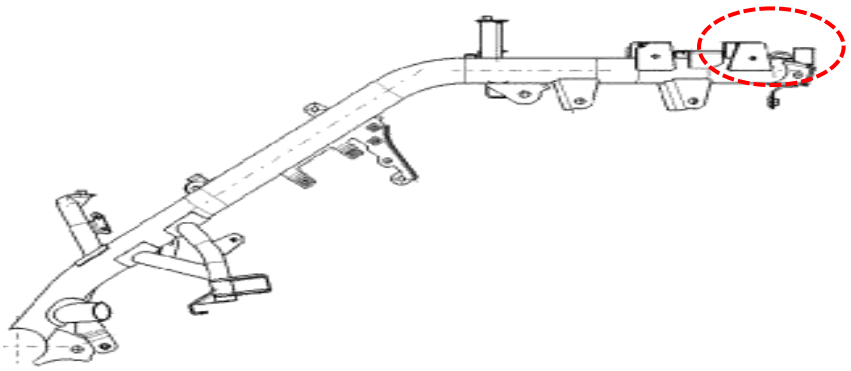

Figure 15 Shown fule tank position in frame body.

A meeting call with every member work on frame body lines for finish this problem by applying poke yoke on weld line. Because lot of manpower used for fuel tank mounting CD rework .

Figure 16 Brainstorming ideas .

Implementation of Poke Yoke

A poke yoke has been done on weld line. A hand jig is implemented for holding fuel tank mounting stay while welding. With help of this hand jig chance of NG part finish.

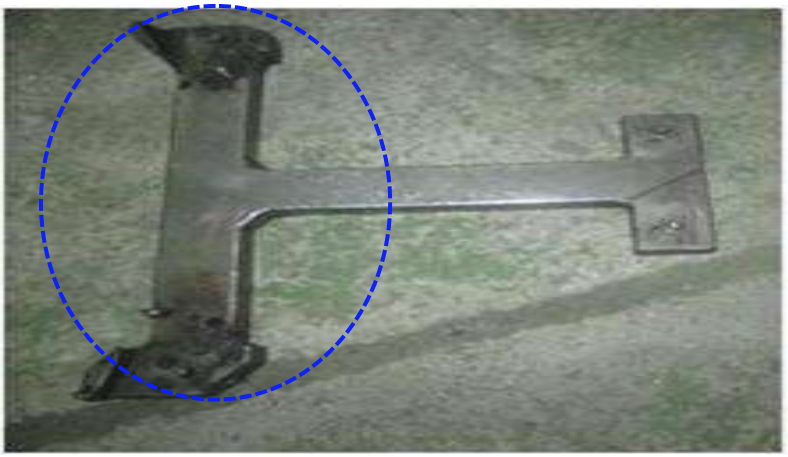

Figure 17 Shown hand jig for holding fuel tank.

RESULT

After applying Poke yoke on Frame body four process problem eliminate for ever. For regular improvement on weld line a poke yoke check sheet implement on shop floor on every line filled by supervisor or engineers works on particular weld line. By Appling this check sheet more problems find and better ideas comes out for implementation of poke yoke.

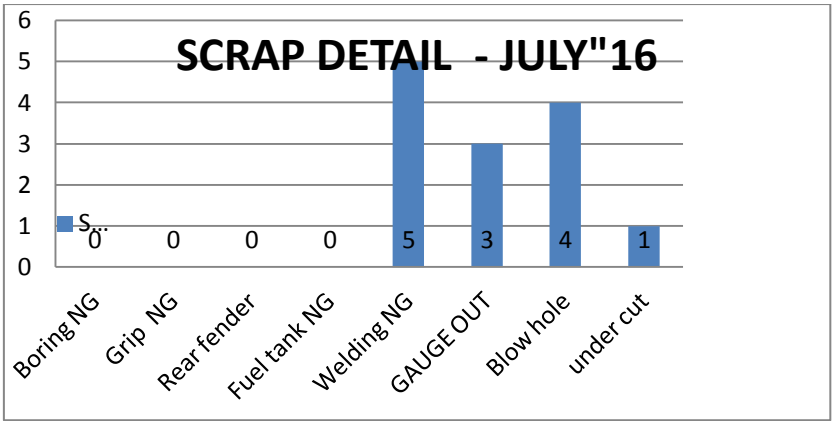

Figure 18 Scrap details.

CONCLUSION

This paper has presented the findings of quality improvement using Poka Yoke technique for a selected automotive part assembly process. This study has identified the problems affecting the quality in Frame Body line model K32. The problem can be overcome by using a sensing device where a mistake proofing device has been proposed and tested. The aim of Poka-Yoke method is to eliminate or minimize human errors in manufacturing processes and management as a result of mental and physical human imperfections. For the main part is to eliminate errors independent (so-called problem resistance to stupidity while-en. fool proof). The main idea of this method is preventing causes, which may result in errors and use relatively cheap control system for determining compliance of the product with the model. In the described organizations Poka-Yoke method in connecting with the quality methods ensure of high quality of produced engine elements, as well as by the continuous monitoring process all allow to minimize cost, and sharing not great effort to improve. Such behavior organization calls for effective implementation of the objectives which are compatible with the system both by the highest quality management and management as well as all workers.

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