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Practical Applications of Quality Control Tools in Auto Components Industry

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Abstract—*The aim of this paper is to present the implementation of quality assurance and quality control tools (QC tools) in the auto component industry. This research work mainly deals to delighting and exceeding the customer requirements through quality control, assurance and reliability. Quality control is the process through which we measure the actual performance, compare it with the standards and take corrective action. The purpose of the paper was showing the practical applications of the quality control tools. The main problem was key auto return movement sticky in the steering lock means when customer start the vehicle key doesn't come back automatically from start to on position of steering lock. Due to this vehicle starter motor continuously on and burn. The task was to do the warranty rejection PPM zero of key set product at customer end. The selection of the quality control techniques is to be applied in this problem. Different analysis and corrective action were done by QC tools like cause and effect diagram, why-why analysis sheet, failure mode and effect analysis (FMEA). With the help of the QC tools the steering lock problem was resolved. After the implementation of the QC tools the warranty rejection failure of steering lock product was going down.*

Keyword*: Quality Control Tools, Quality Assurance and Reliability, Warranty Rejection, Why-Why Analysis, FMEA.*

1. INTRODUCTION

Quality control is as old as industry itself. From the time man began to manufacturer, there has been interest in quality of output. This aspect of manufacturing is gaining increasing importance, now-a-days, because of the fact that unless efficient control is maintained it will not be possible to meet the expected performance and complex specifications of the product. Quality control tools can be used in all phases of the production process. Quality improvement process required and demands the team of experts in the field as well as decision making process. Quality control tools one of the best technical tools for improving product quality and service quality. The seven quality control tools are:

- Flow chart
- Cause-and-Effect diagram
- Check sheet
- Pareto diagram
- Histogram
- Control charts
- Scatter plot

These are seven basic techniques. In which the first four techniques are not really statistical. The word statistical is technical tool not only control the process but has the capability to improve it as well.

2. PRACTICAL APPLICATIONS OF QUALITY CONTROL TOOLS IN AUTO COMPONENTS INDUSTRY

In this paper the systematic approach to the quality improvement is shown on the example of automotive industry. The main purpose of this study was to reduce the warranty rejection PPM of the steering lock. The steering lock problem of the car was solved by the use of the quality tools. Key auto return movement sticky in steering lock means, when customer start the vehicle key doesn't come back automatically from START to ON position of steering lock. Due to this vehicle starter motor is continuously on and burn.

2.1 Warranty Rejection PPM of Key Set

In fig. 4 the data were collected previous nine months. This shows the PPM rejection of the steering lock month wise. There were number of rejection of key set during nine months, this reduced the satisfactions of the customers.

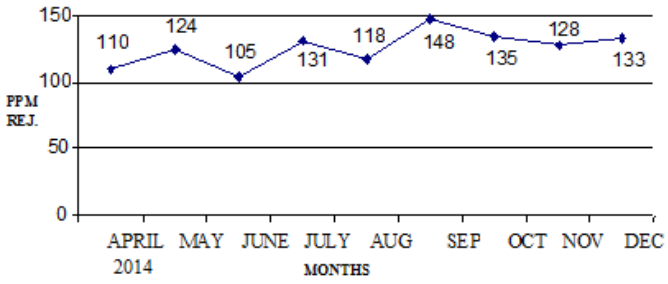

Fig. 4: Warranty rejection PPM of steering lock

2.2 Reason and Analysis

i. Key auto return torque is less from specified torque. It's coming 0.42 kg-cm & its specification is 0.70 kg-cm minimum.
ii. Key auto return torque was less due to circuit making contact plate's contact burn, resulting more friction force between contact plate & contact rivets.
iii. Contact plate's contact burn due to sparking between contact plate's contact & contact rivets. Sparking between contacts due to less contact pressure between contact plate's contact and rivets.
iv. Less contact pressure due to contact plate was not free in rotor. Contact plate was not free in rotor due to contact plate hole diameter 7.0 ~ 7.1 mm was less. It was coming 6.94mm.
v. Contact plate hole diameter less due to hole piercing punch was worn out in tool. Punch worn out in tool due to normal wear & tear of parts.

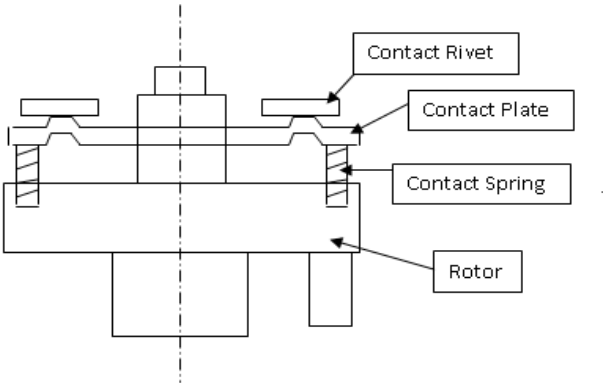

Fig. 5: Assembly sketch of contact plate

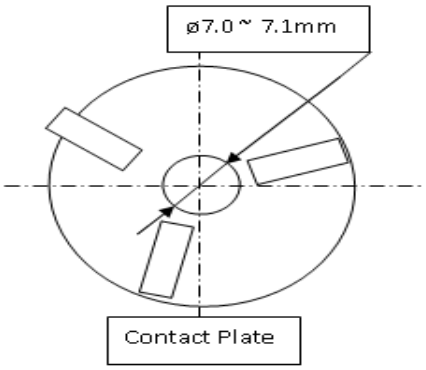

Fig. 6: Sketch of contact plate

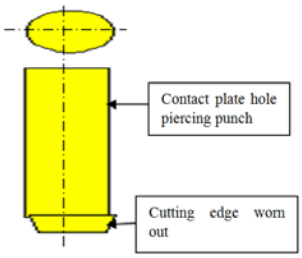

Fig. 7: Defective hole piercing punch of contact plate

2.3 Cause-and-effect Diagram

The cause and effect diagram constructed through the brainstorming technique in which causes were identified organized according to problem. The causes were divided according to Man, Machine, Method and Measurement which help to find out the root causes. Contact plate hole diameter not checked by operator etc. were the causes due to man, Contact plate hole piercing punch worn out in tool were the causes due to machine, Contact plate free movement in rotor not checked by assembly operator etc. were the causes due to method, Contact plate hole diameter less was the causes due to material.

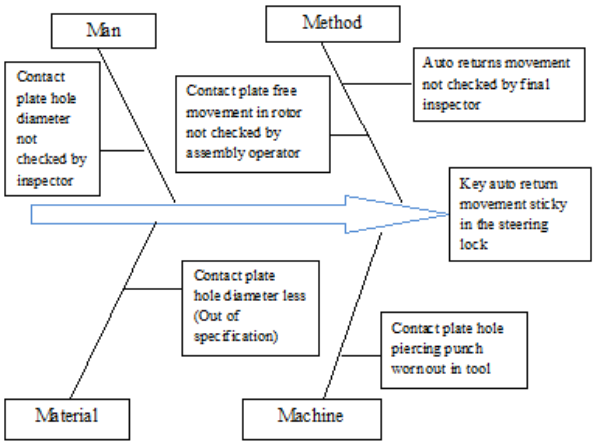

Fig. 8: Cause–and–effect diagram of key auto return movement sticky in steering lock

3. COUNTERMEASURE

Following steps are taken to correct and prevent this problem:

i. Contact plate hole piercing punch changed in contact plate's Press tool.
ii. No. of strokes fixed (10000 strokes) for hole piercing punch for contact plate tool. After that new punch to be changed in tool. This check point added in tool history sheet.

iii. Assembly operator educated and check point added in work instruction sheet, to check the free movements of contact plate in rotor before assembly in each switch assembly.
iv. Final inspection inspector educated and check point added in key set final inspection standard, to check the key auto return movement sticky in each steering lock.

3.1 Why-Why Analysis

It is a method of questioning that leads to the identification of the root cause of a problem. A why-why is conducted to identify solutions to a problem that address its root cause. A why-why helps you identify how to really prevent the issue from happening again. A why-why analysis is most effective in a team setting or with more than one person involved. The practical example of why-why analysis given below:

Defect: - Key auto return movement sticky in the steering lock

Defect	Cause	Action/Countermeasure
Why key auto return movement sticky.	Auto return movement torque 0.7kg-cm minimum less 0.42kg-cm.	___
Why torque less.	More friction force between contact plate and contact rivet.	___
Why more friction.	Contact plate's contact burn.	___
Why contact plate burn.	Contact pressure was less.	Check point added in work standard sheet & operator educated to check the free movement of contact plate in rotor.
Why contact pressure less.	Contact plate was not free in rotor.	Existing lot of contact plate scrapped.
Why contact plate not free in the rotor.	Contact plate hole diameter 7.0+0.1was less 6.94mm.	Punch replaced in contact plate tool. Statistical process study done for diameter 7.0+0.1mm and X-bar, R chart establish to monitor the hole diameter.
Why hole diameter less.	Contact plate hole piercing punch worn out.	No. of stroke fixed (10000 strokes) for contact plate hole piercing punch, after that to be changed in tool.
Why punch worn out.	Normal wear and tear.	

4. RESULT

Warranty rejection failure after these countermeasures is nearly to zero. Only pre-modified rejection is coming which is also going down. We can see the effectiveness of these countermeasures by rejection PPM graph as shown in fig. 10.

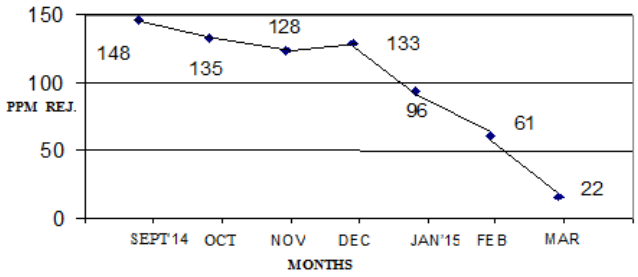

Fig. 10: Warranty rejection PPM of steering lock after countermeasure

5. CONTROL PLAN FOR THE STEERING LOCK

Part No.	Process Name/ Operation description	Machine Device/ Jig tools for mfg.	Characteristics			Special Char/ class	Method						Reaction Plan
			No	Product	Process		Product Process Spec. tolerance	Evaluation measurement technique	Sample		Control Method.		
									Size	Freq.			
A	Rotor assembly in switch case	Manual		Steel ball position should be ok	No Grease Missing	S		Visual	100%		As per Work Std		
B	Contact plate assembly in rotor	Manual		No missing of contact spring	Contact plate should be free in rotor.	S		Manual	100%		As per Work Std		
C	Contacts rivet terminal assembly.	Manual		No looseness of terminal locking.	No grease missing	S		Manual	100%		As per Work Std		
D	Assembly in steering lock	Manual		No looseness of screw	Circuit continuity should be ok.	S		Manual checker	100%		As per Work Std		
E	Inspection	Manual		No missing of part	Key auto return should not be sticky.	S		Manual checking	100%		As per insp. Std.		

6. CONCLUSION

Study has been conducted in order to define role and importance of quality control tools in automotive industry. From the study it is shown that quality control tools can be used in all process phases. The study report shows & explains some of the quality problem which has been faced & solved. In-addition to the above discussion the following quality problem is solved:

S. No.	Problem	Solution
1	Key auto return movement sticky in the steering lock due to the contact plate hole diameter was less.	Contact plate die corrected & X-bar, R control chart established on machine. Study done by cause and effect diagram, why-why analysis, FMEA methods.

In this study, efforts made in understanding the problems occurred during production and process of steering lock.

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