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CORRECTIVE AND PREVENTIVE ACTIONS OF MOTOR CYCLE CYLINDER COMPONENT LEAK PROBLEM ON CASTING PROCESS

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ABSTRACT

Defective product is an undesirable quality product deviation in production process. Defective product is one of main problems in industry. A casting process of motor cycle cylinder component has defective product problems at 4.47% rate. This research aims to reduce the problems with determined target at 3.6%. Plan Do Check Action (PDCA) methods with seven tools as quality assistance instrument is used to analyze the problem and to develop corrective action. The analysis indicated that causes of the problem are undercut and porous on cylinder component. The corrective action related with material, machine and inspection were taken. The result of the corrective action shows a defective product rate at 3.17%. The preventive action was performed to diminish the potential causes of incompatible product for preventing recurrence in the future.

Keywords: PDCA, TQM, corrective action, die casting.

1. INTRODUCTION

Nowadays, motor cycle industry has placed as an immense industry. The production process of motor cycle applies high standard on its product quality. According to Feigenbaum (1991), quality is combination of whole products and services characteristic from marketing, engineering, manufacture, to maintenance where products and services are used to fulfill customers' expectations.

Meanwhile, based on the definition from ANSI/ASQC Standard (1978), quality is totally features and characteristics of the product or services that can guarantee the satisfaction necessity given.

Crosby argued Total Quality Management (TQM) is strategy and integration of management system to enhance customer's satisfaction, to give priority on the involvement of all managers and employees, along with using quantitative methods(Bhat dan Cozzolino, 1993).

Based on ISO 9001: 2008, adoption of quality management system is preferable as strategic decision organization. Design and implementation of quality management system in the organization are affected by

a) Organization environment,
b) Various necessities
c) Main objectives
d) Available product
e) Applied process
f) Organization size and structure

2. LITERATURE REVIEW

Organization should continually improve the affectivity of quality management system by means of using quality policy, quality objectives, audit result, data analyses, corrective and preventive actions, and management considerations.

a. Corrective action

Organization should give actions to diminish the causes of incompatibility in order to prevent recurrence. Corrective action should compatible to the impact of unsuitability faced by organization. Documented procedures ought to be settled to determine the requirements of

a) Incompatibility observation, includes customers complaint
b) Determination of incompatible cause
c) Necessary action evaluation to guarantee the incompatibleness won't occurred
d) Determination and implementation of necessary actions
e) Implemented result action
f) Observation of implemented corrective actions

b. Preventive action

Organization should determine actions to diminish potential causes of incompatibility in order to prevent such things happen. Preventive action must precise to the preventions problems that might occurred.

Documented procedures must be determined to choose necessity

a) Determination of possible incompatibilities and their causes
b) Evaluation actions to prevent incompatibilit
c) Necessarily determination and implementation action
d) Recording result actions taken
e) Affectivity observation of preventive action taken

c. PDCA cycle

PDCA cyle is a method that is used to create continous improvement. PDCA cycle is effectively used in the working process or program running. PDCA cycle possibly to do two types of improvement such ad temporary and permanent. A temporary improvement action aims to handle and to correct practical problems.

Permanent improvement action consists of analysis and diminishing the root causes to reach the process continuous improvement targets. PDCA cycles aspect is applied for procedure of quality guarantee.

PDCA can be utilized as methods for continuous improvement. In ISO 9001, PDCA is a foundation to do continuous improvement. Seven tools (seven quality assistance instruments) is a term from Japan and can't be separated from quality circle and continuous improvement. Seven tools are Pareto diagram, cause-effect diagram, check sheet, histogram, scatter diagram, flow chart, and run chart. Seven tools can be utilized since it is a proven tools to solve a defective problem.

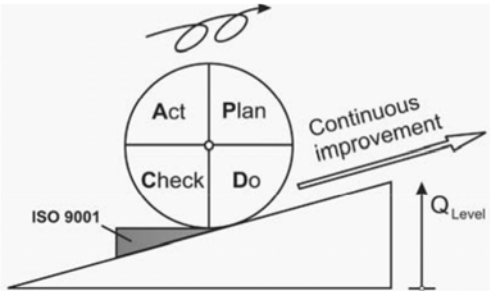

Figure-1. PDCA cycle in sustainable improvements.

3. RESEARCH METHODS

This research uses PDCA methods and theseven tools to analyze a defective problem of a casting process of motor cycle cylinder component leak problems. Focus on this research is on cylinder component part produced by die casting section. The research methodology steps are:

- Problem formulation

Problem formulation stage is defining on what should be repaired from this research. In this case, the percentage of defective product of cylinder component product has not reached the company targets.

- Determining research objectives

This stage is to solve research problem above. The main objective of this research is to reduce the defective product percentage.

- Literature review

Journals and literature studies are required for basic theory needed to get exact corrective method or step in order to be implemented and solving problems on this research. Journals and literature studies refer to book references, or journals from interner or other research relates to this problems.

- Establishing research limitation

Problems limitation is required to get explanation of the research guided, so the misinterpretation of research problem and objectives won't occur. The problem limitation of this research is only on cylinder component part, produced by Die Casting section, and the finishing methods is using the PDCA and quality assistance tools which are seven tools and corrective actions.

- Data collection and calculation

The preliminary data is the defective product of cylinder component data that occurred in Die Casting section of 10 months period. The data was taken from a production process production system database with high accuracy.

After getting preliminary data, data tabulation was processed to determine the dominant type of defective cylinder component, subsequently will be the corrective focus on this research.

- Data analysis

At this stage, researcher performed deep analysis to the all causes factors of dominant type of defective product, in this case the leak problem of cylinder component. Analysis was performed by using PDCA methods and quality assistance instrument, seven tools.

- Develop corrective action

Corrective action is acted to the dominant cause factors of cylinder component leak proble as explained on the anaylis result. Corrective actions are change methods, machine maintenance, and operator training.

- Develop preventive action

To notice the impact of such actions required control of the defective cylinder component data after the corrective actions. In this research, the data taken from 5 months period after the corrective actions.

- Concluding research result

Conclusion is short explanation about all research stages and result achievement, and also proper maintenance efforts to get the targeted level.

4. DATA COLLECTION AND CALCULATION

Data of defective process of Die Casing on the cylinder component from A production process Production System in 10 months on same year as the research can be seen below:

Table-1. Manufacturing defects cylinder component.

Defect	Qty	%
leak on sleeve lube bolt stood	7426	1.20
leak on sleeve to leg shield	4984	0.81
leak on oil pipe up to leg shield	3930	0.64
part apart	3068	0.50
leak on leak tester machine	2303	0.37
else *	5879	0.95
Total	27590	4.47

From the data in Table-1, the defective product percentage of cylinder component in ten months at 4.47% rate. It is above the 3.6% target. Subsequently, the next

step is to determine the type of defective product that will prioritized in the corrective actions in this research to make Pareto diagram.

The Pareto diagram (Figure-2) are shows the calculation for five category amount of defective cylinder component as follow: leak on sleeve lube bolt stood (26,92%), leak on sleeve to leg shield (18,06%), leak on oil pipe up to leg shield (14,24%), Fall apart (11,12%) and leak on leak tester machine (8,35%)

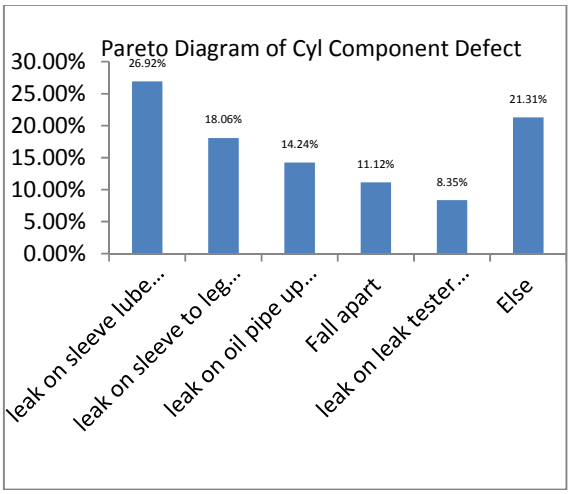

Figure-2. Pareto of cylinder component defect.

There are four defective category at a total of 67.57% rate.These four defective categories are leak on sleeve lube bolt stood, leak on sleeve to leg shield, leak on oil pipe up to leg shield and leak on leak tester machine on sleeve defective. These fourdefective categories became a priority to be handled.

A production process applies quality assurance system to assure best quality to consumers, either for production section, includes Die Casting. Quality assurance system is a system intended to contain quality guarantee in A production process starts from designing to the using of motorcycle product by consumers.

According to the available procedure, if it's found some problems on the production process in a production process it should be made Problem Identification Corrective Action and Preventive Action (PICA-PA). At this level, preliminary lever should be performed by making Problem Identification (PI) by Die Casting section (section where the problem emerged). PI is created as preliminary data to determine and perform corrective and preventive actions (CA-PA) by related section based on organizational coordination result.

5. DATA ANALYSIS

Leak defective is imperfect product as result of oil flow infiltrating to the surface of the product through hole or space inside the cylinder component product. Based on the examination result on the leak cylinder component, mostly the hole or space is initiated from two basic things which are:

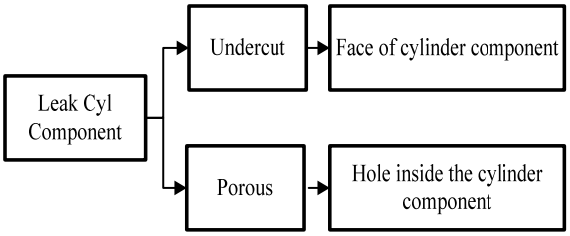

Figure-3. Analysis of primary causes of disability leaking cylinder components.

From Figure-3, further analysis is required to comprehend the cause's factors of undercut and porous on the cylinder component. Below are the cause-effect diagram of undercut and porous problem on the cylinder component (Figure-4 and Figure-5)

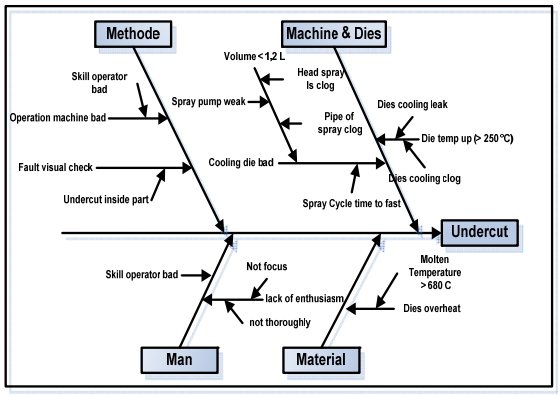

Figure-4. Cause and effect diagram undercut cylinder components.

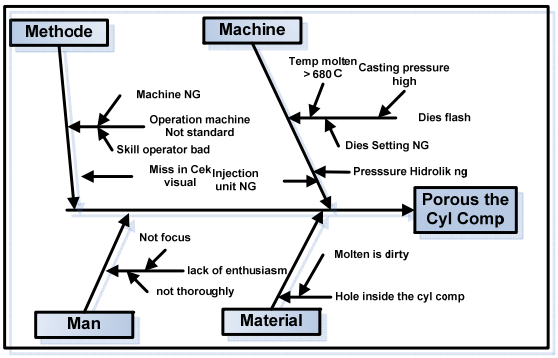

Figure-5. Cause and effect diagram component porous cylinder.

6. CORRECTIVE ACTION

Corrective action aims to diminish cause's factors of the emerging problems and to prevent recurrence. Based on the problem analysis that has been done, performed corrective action entails two main problems, undercut and porous.

7. UNDERCUT CORRECTIVE ACTION ON CYLINDER COMPONENT

a. Material

Corrective action is acquired to maintain molten temperature in holding on 660 ± 20 ºC by sustaining molten distribution pattern from melting rate 750 ºC which performs molten temperature checking on holding every hour, so it can lessen or even diminish uneven molten temperature.

b. Machine

For machine, the corrective step required is by correcting unit spray to maintain debit at 1.2 litre. Corrective action is performed on some part of spray unit in the Die Casting machine or in the pipe line and collecting basin (container). Corrective activities are as followed:

a) Auto spray changing
b) Corrective action on spray pipe lines and auto spray basin drainer
c) Pump Auto spray changing
d) Repair and replacement pin dies

c. Checking method

For detecting undercut part, it is not enough to rely on visual part checking either by operator or QCL, especially for the inside part. Therefore, it requires additional method apart from visual which is by stretch checking part method

8. CORRECTIVE ACTION OF POROUS CYLINDER COMPONENT

a. Material

The cause of porous on the cylinder component is molten dirt/waste, therefore required corrective step to clean the dirt/waste inside molten in holding furnace. The waste cleaning process inside the holding furnace is performed by fluxing method or dirt/waste removal in holding

b. Machine

Corrective action on machine to prevent porous is by maintaining good hydraulic pressure of die casting machine. Correcting actions which are performed:

1. Checking and adding nitrogen pressure on accumulator tube to 85 MPa.
2. Checking and changing broken or time-worn injection unit

c. Inspection method

For detecting porous part, it is not enough to rely on visual part checking either by operator or QCL, especially for the inside part. Therefore, it requires additional method apart from visual which is by stretch checking part method.

9. PREVENTIVE ACTION

Preventive action was performed to diminish the potential causes of incompatible product for preventing recurrence in the future. Below are preventive actions for each factor

Table-2. Preventive action defective leaking cylinder component.

Maintenance items	Period	PIC
Material		
Control holding furnace temperature	1 hour	Melting Operator
Cleaning holding furnace	2 week	Melting operator
Replace holding furnace	2 year	Process Engineering
Machine		
Check nitrogen pressure	1 month	Technician
Check hidrolik oil	Every start prod	Dies Casting operator
Replace hidrolik oil	1 year	Process Engineering
Replace plunger tip	7.000 shoot/NG	Technician
Replace plunger sleeve	60.000 shoot/NG	Technician
Replace auto spray	10.000 shoot	Technician
Cleaning auto spray	10.000 shoot	Technician
Check spray pump	1 month	Process Engineering
Dies		
Maintain slide core dan dies pin	3.000 shoot	Dies Maintenance
Maintain and replace dies	10.000 shoot	Dies Maintenance
Operator		
Upgrade skill competency	6 month	Section head

10. CORRECTIVE RESULT VERIFICATION

Corrective step is performed to fix all factor that could initiate leak defective on cylinder component. The corrective action is by pressing potential occurrence of undercut and porous on cylinder component based on explanation at preventive and corrective level previously.

Defective data is taken in five months after corrective actions. From the data Table below (Table-3), shown that achievement of total defective cylinder component for five months at 3.17%. This amount is below maximal limitation percentage defective product at 3.60%. This achievement also indicated 1.3% less amount than before corrective action at 4.47%. from the result, can be concluded that corrective action which is performed, can

compress the amount of defective cylinder component product up to under maximal limitation of defective cylinder component at 3.60%.

Table-3. Component defect data cylinders after repair.

Defect	Qty	%
leak on sleeve to leg shield	2,683	0.92
leak on sleeve lube bolt stood	1,288	0.44
leak on oil pipe up to leg shield	559	0.19
part apart	1,117	0.38
leak on leak tester machine	695	0.24
else	2,922	1.00
Total	9,264	3.17

11. PICA-PA LEAK DEFECTIVE OF CYLINDER COMPONENT

PICA-PA is a form of corrective problem that can perform to answer in problem treatment at production process. Furthermore, it also can accomplish ISO 9000 provision about procedure and documentation of every problem treatment.

PICA-PA for leak defective problem on cylinder component can be created from some parts:

- Problem Identification (PI) by Dies Casting (Production) as a party or section where the problem emerged
- Corrective and Preventive Action (CA-PA) by Dies Casting, Process Engineering and Dies Maintenance as party or section to perform corrective actions

PICA-PA is document filled with problems and its problem causes which are initiated by the high leak defective on cylinder component. The problems, then, were analyzed in order to know the cause's factors of the occurrence problems. This analysis contains 5 why analysis, corrective and preventive actions by production process, engineering, and dies maintenance section through result of collective meeting. Subsequently, result of corrective evaluation is performed by seeing the corrective result monitoring. If the company capable to lessen the problem of defective cylinder component, then decided that status from PICA-Pa is closed, means cylinder component problem has succeed to be resolved with the corrective activities given.

12. CONCLUSIONS

Based on the results of research can be conclusion the following:

- There are several factors that could potentially lead to the occurrence of leak defects are :

a) Molten material that is dirty and temperature is too high.
b) Auospray unit machine condition is not good, injection pressure labile, dies overhead.
c) Lack of the operator skill and the operator is not careful when checking part.
d) There is no method of checking the symptoms of leaky defect.

- Undercut and porous cylinders in the product component identified as the initial symptoms of defect in component of the cylinder is leaking.
- Corrective and preventive action activities in accordance with ISO 9001:2008 by the method of PDCA and seven quality tools as aids in this study is quite effective in lowering the level of product defect cylinder component of 4,47% to 3,17% after the improvements.

Based on the results of factor analysis that there are still some factors that have not performed further analysis, such as consistency operator (human), stability of the machine, and the design of dies.

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