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Problems During the Throttle Body Production Process at PT HK Manufacturing

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Abstract
The throttle body is one of the important components in the vehicle's fuel system, especially those that use electronic fuel injection (EFI) technology. This component serves as the main conduit to deliver air to the intake manifold. However, in the production process of throttle bodies, there are a number of problems that affect product quality, such as leaks, dents, pin holes, yuhike, and rust. These problems not only impact the efficiency of vehicle use, but also reduce consumer satisfaction and increase production costs due to wasted time on repairs. This study aims to identify the main causes of these problems, such as errors in the installation of components, inappropriate temperature conditions, and the influence of humidity. With quantitative methods, this research involves observation and visual inspection on the products produced, including leak tests with Leak Test machines. The results of the study show the need for design improvement, material quality control, and the implementation of better production strategies to reduce the defect rate. The implementation of this solution is expected to increase production efficiency, optimize the quality of the throttle body, and meet consumer needs and desires.

Keywords: Production Problems, Throttle Body, Manufacturing

Introduction

In the world of manufacturing, maintaining product quality is one of the most important aspects, especially for vehicle components such as throttle bodies. The throttle body is an essential part of the vehicle's engine system that functions to regulate the airflow to the combustion chamber. However, in the production process, it is often found that products with quality that do not meet the standards or are called "not good." This can be caused by a variety of factors, such as design errors, inappropriate materials, or failures in the manufacturing process.

The optimal performance of the throttle body plays a major role in determining combustion efficiency, vehicle performance, and exhaust emission levels. In the production process, the throttle body must be produced with high precision and consistent quality to ensure its function runs according to specifications. The throttle body is also one of the important components in vehicle engines, especially in the fuel injection system (EFI – Electronic Fuel Injection). THB is located between the air filter and the air chamber.

The main function of the throttle body is as the main channel through which air will pass before being flowed to the intakemanifold. Engines with EFI injector technology work as fuel injectors to the Tb (throttle body) inlet. Air will flow through these components when we operate the throttle valve with the throttle grip.

Based on the survey that has been conducted, there are several problems that are often encountered in the Throttle body, including leaks in the Throttle body, dents, pin holes, yuhike, and rust on the Throttle body and parts. This will certainly reduce the efficiency of using motor vehicles, which will also have an impact on consumer dissatisfaction. Therefore, it is necessary to conduct this research to find out the causes of leaks, dents, pin holes, yuhike, and rust on the body and Throttle body parts. By knowing the cause, we can make improvements to the design or production strategy so that we can optimize the efficiency of the Throttle body itself.

Product quality is an important concern for companies when making products. Improving product quality is the main criterion for consumers when choosing products offered by companies. The Company has always had the ability to maintain and improve the quality of products to meet the desires of consumers, allowing the Company to compete with competitors and dominate the market. A product that can be accepted by consumers is a product that meets the needs and desires of consumers with a minimum level of disability. Companies that do not pay attention to improving the quality of their products will commit suicide or do not care about the future of their company, because improving product quality will have an impact on consumer purchasing decisions.

Companies must always supervise the production process of their products so that the improvement of product quality remains good and in accordance with the standards that have been set by the company. If supervision and production processes are carried out carefully, it will have a positive impact on the company, including defects or damage to products can be minimized or even eliminated. Delays in material stock can lead to disruption of throttle body production, increased operational costs, and decreased customer confidence. The factors that cause delays are often multidimensional, involving people, methods, materials, machines, the environment, and management. Production delays are one of the critical problems that the manufacturing industry often faces. These delays can lead to failure to meet delivery schedules, reduce customer satisfaction, and increase production costs. Therefore, it is important to identify the root cause of the delay and implement a systematic approach to address it.

Throttle bodies that are defective or of poor quality in the production process can cause performance problems in the vehicle and have implications for production costs. This study reviews various factors that cause the throttle body to be "not good" in the production process, analysis methods, and improvement efforts.

1. Definition of Throttle Body in Production Process
   The throttle body is an important component that regulates the airflow to the engine. In the production process, the throttle body must meet certain quality standards to ensure its optimal function.
2. Defective Characteristics (Not Good) in Production
   Throttle bodies that are declared "not good" usually have the following characteristics:
   - Mismatched dimensions: Size mismatches due to mold or machining errors.
   - Defective materials: Raw materials of low quality or not according to specifications.
   - Sensor malfunction: The throttle position (TPS) sensor fails to function due to damage during assembly.
   - Mechanical damage: The valve does not move smoothly due to inaccurate tolerances.
   - Rough surface or visual defects: Errors in surface finishing such as scratches or premature corrosion.

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3. Causes of Throttle Body "Not Good" in Production
   Some of the main causes are:
   - Design errors: Too tight design tolerances or lack of prototype testing.
   - Machining process failure: Errors in machining processes such as drilling, milling, or plating.
   - Poor quality control: Inability to detect defects during inspection.
   - Assembly errors: Components are not assembled correctly or use inappropriate tools.
   - Non-standard materials: The use of low-quality raw materials or those that do not meet OEM standards.
   - Production environment: Environmental factors such as dust or humidity that affect sensitive components.

Method

This study aims to describe and analyze the data obtained. The main purpose of descriptive research is to uncover current facts through the process of describing, recording, analyzing, and interpreting ongoing conditions. The study uses a case study design, which allows for an in-depth investigation of a specific subject to provide a thorough understanding. The data used includes primary data obtained from internal information of PT HK Manufacturing, as well as secondary data from journals, books, and other documents relevant to this study.

Type of Research

This study uses a quantitative method in accordance with the research objectives. According to I Made Laut (2020:6), the quantitative method is a type of research that produces several results using other quantification (measurement) techniques. The quantitative approach focuses more on symptoms or phenomena that have certain characteristics in human life. Variables, on the other hand, are analyzed through an objective theory of the relationship between variables.

The method used in this study uses a quantitative method. This method uses observation and observation to research problems in the Throttle body production process. Where in these observations leak checks are carried out on the LEAK TEST machine and visual checks by Final Inspection. The quantitative research method focuses on objective measurements and direct data collection in the field through direct observation, analysis, and data collection based on information obtained during November 2024.

Fisbone Diagram

Fishbone diagrams, or Ishikawa Diagrams, can be used as a tool to support the implementation of Total Quality Management (TQM) by providing a systematic approach in identifying root problems in the production process. In the case of production delays, the combination of these two methods can result in a more focused and effective remediation solution. The data obtained was analyzed using the Fishbone method to determine the root cause of the problem, which is grouped into five main categories: human, method, material, machine, and environment.

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Result and Discussion

The following is a table of problems in the production of Throttle Body in November 2024. The production target plan is 6600 pcs/day. There are 20 working days in November. So the total pla is 13200 pcs.

Table 1. Problems in Throttle Body Production for the November 2024 Period

It	Problem Type (Not Good/NG)	Quantity NG in November	Average quantity per day
1.	Leaky	3000	150
2.	Dent	600	30
3.	Yuhike	340	17
4.	Pin Hole	260	13
5.	Rust	100	5
Sum		4300	215

To repair 1 pcs of the product takes 1 minute. From the data in the table above, it is known that there are several problems in the production of Throttle Body. On average, there are 215 pcs of NG products per day. Which causes loss time in the production process per day. The following is a calculation of the time needed to repair NG products within one day.

$$Total\ waktu\ repair\ perhari = \frac{215\text{pcs}.\ 1\text{min}}{60} = 3{,}58\ jam$$

From the calculation above, it takes 3.58 hours just to repair NG goods.

The throttle body is an important component in the fuel and air systems of internal combustion engine vehicles, especially in gasoline-fueled engines that use injection technology. The throttle body functions as a door to regulate the amount of air entering the engine combustion chamber. This component is usually located between the air filter and the intake manifold, being the main link between the air system and the engine.

The throttle body functions to regulate the airflow to the engine based on the power needs desired by the driver. When the gas pedal is pressed, the throttle body opens the valve, allowing more air to enter the engine. This process allows for a larger mixture of air and fuel, which ultimately increases engine power. In contrast, when the gas pedal is removed, the throttle body closes or only opens slightly to restrict airflow, reducing engine power.

There are several problems in the Throttle body production process, which are as follows:

1. Leakage

From the table above, it is concluded that the most problems are leaks that have been checked on the Leak Test machine. A leak in the Throttle body is the escape of air through an improper path. There are several causes of leaks as follows:

a. Rubber seals that are damaged due to imprecise rubber seal installation.
b. The diameter of the throttle valve that does not match its size causes a gap, resulting in a leak.

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It must therefore be addressed by:

a. To repair the leak, it is necessary to replace the rubber seal. For long-term repair, the rubber seal installation process must be carried out carefully, so that the seal is installed with precision and does not cause leaks.

Figure 1. Rubber Seal Adjust Screw On Throttle Body

b. Measurement of the throttle valve at the beginning of the work, preventing the wrong size of the throttle valve.

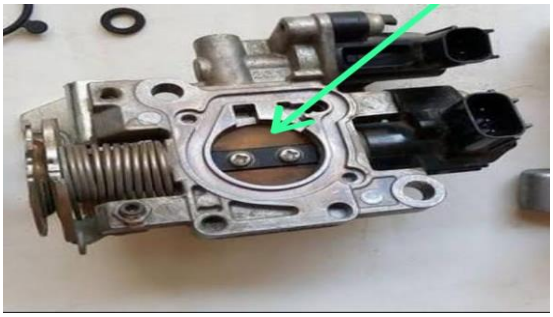

Figure 2. Thttle Valve On Thorttle Body

2. The dent is the indentation in the Throttle body. The cause is due to a collision in the production process. The impact is structural loss, aesthetic decline, economic loss, functional damage.

Figure 3. NG Dent on Throttle Body

How to Deal with Dent
Prevention:
1. Worker training: Train operators to handle components carefully
2. Use of the right tools: Using fixtures and jigs designed to prevent overpressure.
3. Safe packaging: Protect products with protective materials during transportation and storage.

Repair
Rework process:

For small dents, use methods such as light heating and leveling. Use a pneumatic dent remover for hard-to-reach dent areas. Sanding and smoothing: Sanding the dented surface until it is flat, then refinishing. Rewelding: If the dent is too deep, use welding and remachining.

3. Yuhike is an NG body due to uneven melting temperature, the impact is structural loss, aesthetic deterioration, economic loss, functional damage.

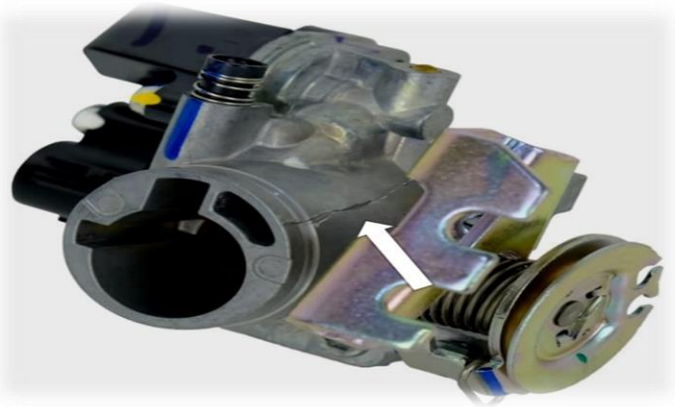

Figure 4. NG Yuhike on Throttle Body)

Repair:
1. Rework: For minor defects, use processes such as polishing, grinding, or remachining. Re-coating to repair damaged surfaces.
2. Replacement of components: If the defect is too severe, replace the components with new ones to maintain the overall quality.
3. Welding or filling techniques. Use welding or filler techniques to correct structural defects, apply refinishing after repair to ensure uniformity.
4. Re-inspection: Use the Non-Destructive Testing (NDT) method to ensure effective repairs without damaging the product.

5. A pin hole is a small hole in the body that should not be there. The cause is air trapped during the smelting process. The impact is structural loss, aesthetic decline, economic loss, functional damage.

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Figure 5. NG Pin Hole On Throttle Body)

How to Overcome a Pin Hole
Prevention:

1. Material cleaning: Clean the raw materials from contamination before use.
2. Optimization of the casting process: Use the right pressure and temperature.
3. Add ventilation or degassing to prevent gas from trapping.
4. Tool inspection: Make sure the tool and mold are free of dirt and defects.
5. Environmental control: Keep the humidity and temperature in the production area.

Repair:

1. Refilling: Use a special filler material to seal the pin holes in the metal or coating surface.
2. Microwelding process: Use welding techniques on a small scale to seal the hole without damaging the surrounding area.
3. Additional protective layer: Apply a coating to hide and strengthen the pin hole area.
4. Additional inspection: Use non-destructive testing (NDT) techniques such as dye penetrant or ultrasonic to ensure the pin hole has been resolved.

Rust is a corrosion product that forms on metal surfaces, especially iron and steel, as a result of chemical reactions between metals, oxygen, and water (or moisture). Rust often appears as a brittle reddish-brown coating and does not protect the metal from further damage. The causes are chemical reactions (iron corrosion), moisture, exposure to air and oxygen, damage to the protective layer, metal contamination. The impact is structural loss, aesthetic decline, economic loss, functional damage.

Figure 6. Rust on the Throttle Body

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How to deal with a rusty throttle body:

1. Choose products that are safe for throttle body components, such as mild acid-based anti-rust fluids (e.g., WD-40 or special rust removal fluids). Spray the liquid onto the rust-affected area, let it sit for a few minutes, and then scrub it using a soft-bristled brush or microfiber cloth. Use fine sandpaper or a soft wire brush.
2. For heavier rust, use sandpaper with fine grit (800*1000) to scrape away the rust layer without damaging the throttle body surface. Avoid excessive pressure to avoid eroding the metal material.
3. Coating
   Once the rust has been removed, apply a protective coating to prevent rust from returning: Use anti-Rust paint or a sificon-based brace make sure the coating is even and does not interfere with the mechanical function of the throttle body
4. Replacement of Defective Components
   If the rust is too severe and causes the throttle body to not function properly, consider replacing the throttle body with a new unit. Choose a throttle body with a rust-resistant material, such as anodized aluminum or metal with a protective coating.

Prevention of Rust on Throttle Body
Regular Maintenance:

1. Clean the throttle body regularly to remove dirt, oil, or moisture. Use a safe throttle body cleaning fluid for sensors and mechanical components.
2. Use Lubricant or Anti-Rust:
   Apply a lubricant or anti-rust liquid to exposed parts of the metal. Choose a lubricant that is compatible with the throttle body so as not to damage other components.
3. Repair Damaged Seals or Covers
   Check the seal or gasket that protects the throttle body from moisture. Replace worn or leaking seals to prevent water from entering.
4. Environmental Control:
   Avoid parking in humid areas for long periods of time. If the vehicle is frequently used in wet conditions, make sure the engine compartment is kept dry.
5. Use Stainless Material:
   If possible, choose a throttle body made of a material with high corrosion resistance, such as stainless steel or anodizing coated aluminum.

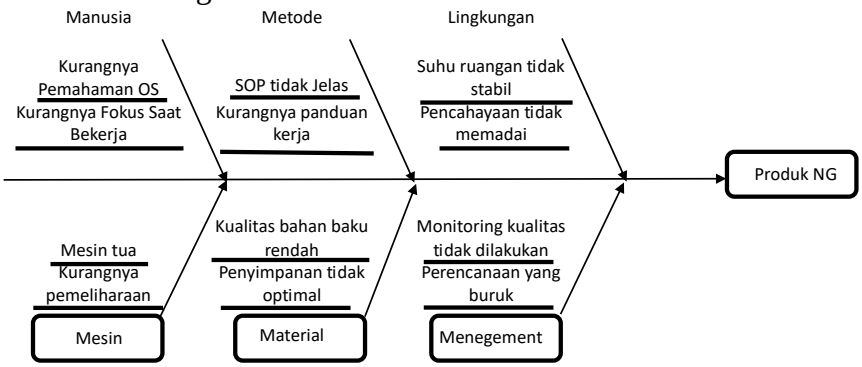

Figure 7. Fishbone Diagram

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The fishbone diagram establishes failures in the production process as the main focus, which is placed at the head of the diagram. Meanwhile, "fish bones" describe the causes of problems based on factors such as man, machine, method, management, material, and environment.

1. In the human factor, it was found that the lack of understanding of OS for employees regarding machine operation and correct work procedures was the main cause. The high turnover rate disrupts the stability of the workforce, while non-compliance with standard operating procedures (SOPs) also worsens the situation. PT HK Manufacturing addresses this with a policy of assigning employees in the quality assurance department or management to oversee the production process. This step aims to prevent production failures that lead to defective products (NG) due to exceeding the limits of inspection standards. With regular supervision, the risk of increasing the number of defective products can be minimized.
2. In the machine factor, it was found that equipment that does not meet quality standards, the absence of a routine maintenance plan, and the use of old machines that are forced to continue working can cause sudden damage. This has an impact on decreasing product efficiency and quality.
3. In terms of material factors, the use of raw materials that do not meet standards affects the production process and final results. Storage of raw materials that do not take into account temperature and humidity can cause material damage, such as deformation, which ultimately degrades the quality of the product.
4. In the method factor, the lack of standard work guidelines can cause inconsistencies in the production process. The absence of continuous improvement, structured quality control, and inefficient work processes slow down production.
5. In environmental factors, elements such as temperature, humidity, and lighting affect the production process. The quality of raw materials can deteriorate, and poor lighting in the production area reduces the operator's ability to detect defects in the product, thereby increasing the risk of undetected defects.
6. Finally, in the management factor, poor planning results in unrealistic production schedules, causing delays. Lack of quality monitoring and the absence of periodic evaluation to detect and prevent problems are additional causes in the decline in the quality of the production process.

5W1H

1. What
   The throttle body is an important component in the vehicle's fuel system that often experiences problems during the production process. The problems include leaks, dents, pin holes, yuhike, and rust, which affect product quality, vehicle efficiency, and customer satisfaction.
2. Who
   This research was conducted by Aktsa Alfajri and her colleagues from Pelita Bangsa University, in collaboration with PT HK Manufacturing, which is responsible for the production of throttle bodies.

3. Where
   This research was conducted at PT HK Manufacturing, located in Bekasi, West Java.
4. When
   The data in this study was collected during November 2024, focusing on throttle body production problems during that period.
5. Why
   The research aims to identify the main causes of throttle body production defects and provide solutions to improve production efficiency, product quality, and consumer satisfaction.
6. How
   The research uses quantitative methods with direct observation, visual inspection, and leak tests using the Leak Test machine. Data analysis was carried out using fishbone diagrams to identify the root of the problem and relevant solutions.

Conclusion

This study identifies various problems in the throttle body production process at PT HK Manufacturing, which significantly affects product quality, process efficiency, and consumer satisfaction. In the production of throttle bodies, there are production defects in the form of leaks, dents, pin holes, yuhike, and rust. This defect not only increases production costs due to the need for refurbishment but also reduces the competitiveness of the product in the market.

The root of the problem:

Analysis using fishbone diagrams reveals that the root cause of the problem includes the following factors:

1. Human factor (man): Lack of operator understanding of SOPs and machine operation. The high turnover rate affects the stability of the production team. Non-compliance with work standards leads to inconsistencies in product quality.
2. Machine factor: Obsolete and poorly maintained production machines cause sudden failures. The tools used do not meet the standards, resulting in defects during the production process.
3. Material factors: The use of raw materials that do not meet OEM standards, such as low-quality materials. Suboptimal storage of raw materials, which leads to material damage due to unsuitable humidity or temperature.
4. Method factor: Lack of structured and consistent work guidelines. There is no continuous evaluation and improvement of the process.
5. Environmental factors: Unstable room temperatures and inadequate lighting affect the operator's ability to detect defects.
6. Management factors: Poor quality monitoring leads to defects not being detected at an early stage. Unrealistic production schedules increase the risk of failure in meeting targets.

Impact of the problem:

From the data collected during November 2024, an average of 215 NG products were found per day. Each product repair takes 1 minute, which means a daily loss time of 3.58 hours. This accumulated lost time contributes to increased production costs and decreased operational efficiency.

Recommended Solutions:

1. HR Competency Improvement: Train operators to comply with SOPs properly. Placing a quality assurance team that specifically oversees the production process.
2. Machine Modernization: Replacing obsolete equipment with modern machines that have higher precision. Establish a regular maintenance schedule to prevent sudden damage.
3. Material Control: Ensure the use of raw materials as per OEM standards. Provides storage facilities that maintain humidity and stable temperatures.
4. Production Method Optimization: Using tools such as fixtures to prevent defects during production. Implementing a Total Quality Management (TQM) approach to increase efficiency.
5. Environmental Management: Ensure the production area has sufficient lighting. Stabilizes the temperature and humidity in the production area.
6. Management Improvement: Develop a more realistic production schedule and improve process monitoring on a regular basis.

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