ARCHIWUM INŻYNIERII PRODUKCJI
PRODUCTION ENGINEERING ARCHIVES

2014, Vol. 2, No. 1, pp 16 -19
ISSN 2353-5156 (print version)
ISSN 2353-7779 (online version)

Article history: Received: 12.11.2014 Accepted: 02.01.2014 Online: 30.06.2014

Available online on: http://www.qpij.pl **Exist since 4rd quarter 2013**

Applying the 5 Why method to verification of non-compliance causes established after application of the Ishikawa diagram in the process of improving the production of drive half-shafts

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Abstract The automotive industry is one of the most important branches of the global industry. For this purpose, products are produced by an extensive network of suppliers. They supply components directly to the (OEM - Original Equipment Manufacturer) or to the secondary market of parts. In recent years, the economic situation in these companies has dramatically deteriorated and it is associated with a decrease in new car sales. These companies are constantly making decisions to improve their production processes using various quality tools. These actions may help to increase their competitive advantage and thereby improve their financial situation. The surveyed company produces drive half-shafts for different types of cars. The studies were carried out to analyse the causes of non-compliance - falling band from the housing on the drive shaft. In order to identify and verify the causes for non-compliance and undertake corrective action following methods were used: Ishikawa diagram, 5WHY and brainstorming.

Key words - 5WHY, Ishikawa diagram, brainstorming, drive half-shafts, improvement, automotive sector

1. Introduction

The analysed company launched its manufacturing operations with the start of the Great Revolution of industrialization in the early twentieth century and now is a leading supplier of propulsion systems for the automotive industry. This company is a world leader in the production of constant velocity joints, as well as in the design and manufacture of components and systems for power transmission in motor vehicles (Materials from the analysed company in 2012). The company is fully aware that parts of automobiles must

satisfy a number of economic, qualitative requirements, including industry and individual, specified in the specifications of the customer. The company realizes that the production process is particularly important to control the key parameters as well as quality control of products having a direct impact on the safety of users (INGALDI M., JAGUSIAK-KOCIK M. 2013; BORKOWSKI S., STASIAK-BETLEJEWSKA R. 2011, BORKOWSKI S. 2013).

2. The aim and methodology of research

The main objective of the study was to verify the causes for non-compliance previously identified by the use of Ishikawa diagram. For the verification of the causes was used 5WHY and brainstorming methods. The study aimed to improve the production process of drive half-shafts. The study was conducted in 2012.

3. Research methods characteristics

The methods used in this study are:

1) Method 5WHY (5W). It is a method that detects the causes of quality problems or failures by asking a few questions, "Why?" It allows to get to the root of the problem, thoroughly analyse the cause and focus on the efficient solving. By asking more questions, "Why?" problem becomes more understandable, so that can apply remedial measures to eliminate a particular non-compliance. The main advantages of this method are its efficiency and uncomplicated nature. The method can be used in every company. However, it requires logical thinking and independent problem identification by the research team (BORKOWSKI S., KRYNKE M., INGALDI M. 2012).

2) Ishikawa diagram otherwise known as the cause-effect diagram shows the causes of a specific quality problem in their mutual dependence. Typically, in manufacturing settings the appearance of the non-compliance is analysed due to main causes such as: Man, Machine, Material, Method, Management and Environment. In service settings, Machine and Method are often replaced by Policies (high level decision rules), and Procedures (specific tasks). Number of the causes is dependent on the complexity of the problem, may be different and need not be strictly limited to 5M + E (HAMROL A. 2007; PIIEKARA A., DZIUBA S.T., KOPEC B. 2012).

3) The method of brainstorming is a method of teamwork. In this method, thanks to creative thinking, can find original solutions that go beyond of schematic thinking. Obtained ideas typically must be further analysed in the later stages of solving quality problems.

An important aspect of this method is the separation of the two phases - the phase of creating ideas and the phase their evaluation, explanation. The purpose of first phase is to collect the largest number of ideas. In the second phase, the list of ideas is verified. Accepted ideas should be divided in a manner that clearly indicates the problem and its solution. This method is used in the method 5 WHY and Ishikawa diagram (INGALDI M., SELEJDAK J., GAJDA P. 2013; DZIUBA S.T., PIEKARA A, MALAS W., KOZIOŁ P. 2013, KRYNKE M., MIELCZAREK K. 2013).

4. Identification of the problem

The client filed a complaint describing it as follows: during the operation of the car, band mounted on a joint from the wheel's side, slides off from the housing to the drive axle (Fig. 1) under the influence of rotation, causing unsealing and leakage of grease, which can cause of the bearing seizure.

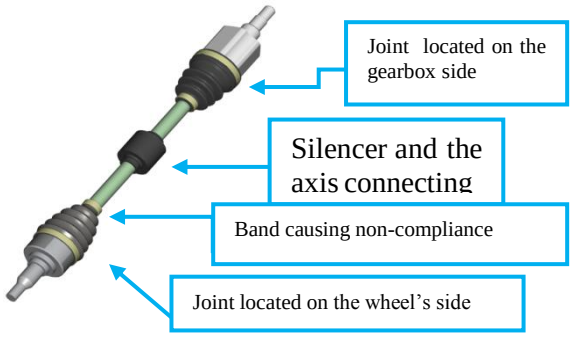

Fig. 1. Front drive half-shaft

Source: own study based on company materials

Detailed analysis using Ishikawa diagram (Fig. 2) carried out in a separate study (DZIUBA S.T., JAROSSOVÁ M. A., GOŁĘBIECKA N. 2013) showed that the main causes of non-compliance are: 1) error of the housing applying station, 2) incorrect position of the

housing on the shaft, 3) incorrect parameters of the band's fastening.

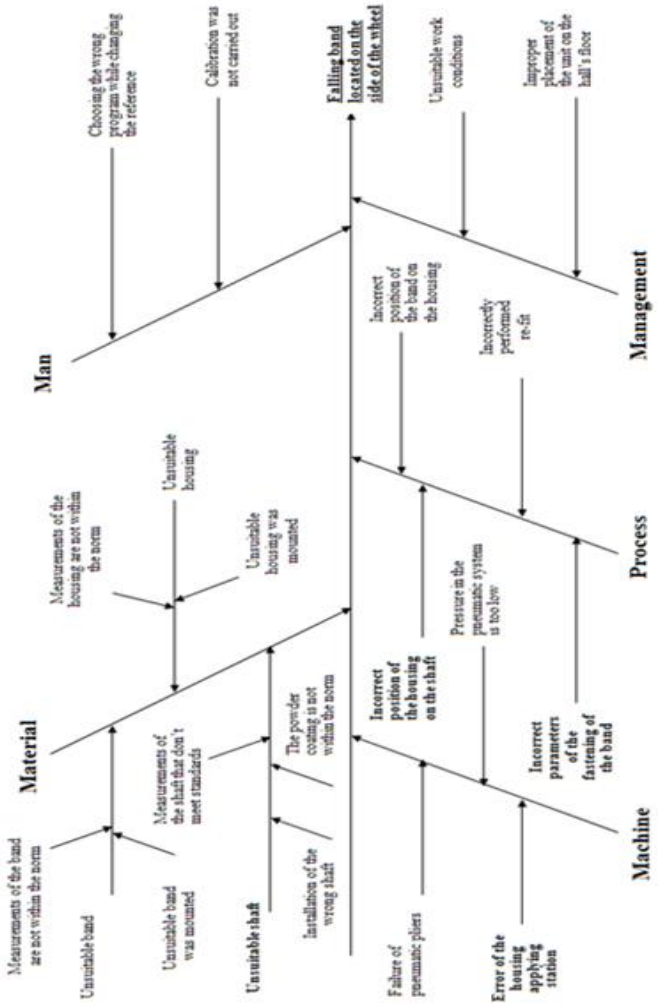

Fig. 1. Ishikawa diagram relating to the falling band located on the side of the wheel

Source: DZIUBA S.T., JAROSSOVÁ M. A., GOŁĘBIECKA N. 2013

To re-verify the causes of non-compliance „falling band located on the side of the wheel "was used 5WHY method. In considering the problem by 5WHY method, the question "why" is asked until the source of the error has not been identified. On the brainstorming basis were chosen three main causes to analyse, namely: 1) incorrect position of the housing on the shaft, 2) incorrect parameters of the band's fastening, 3) failure of pneumatic pliers.

Problem 1: Incorrect position of the housing on the shaft

Question 1: Why has the incorrect position of the housing on the shaft occurred? Answer: Groove located on the housing was not on the right place of the shaft.

Question 2: Why groove located on the housing was not in the right place on the shaft? Answer: Constant resistance at the housing assembly station was incorrectly established.

Question 3: Why the constant resistance at the housing assembly station was incorrect established? Answer: Ring locking joint before disconnecting could be placed under the head assembly retaining housing position on the shaft.

Question 4: Why the ring locking the joint before disconnecting could be placed under the head assembly retaining housing position on the shaft? Answer: The rings were lying loose on the assembly table.

Question 5: Why the rings were lying loose on the assembly table? Answer: There are no cuvettes on the rings.

Problem 2: Incorrect parameter of the band's fastening.

Question 1: Why have occurred incorrect parameters of the band's fastening? Answer: There were entered incorrect values in the machine panel.

Question 2: Why were entered incorrect values in the panel of the machine? Answer: Everyone had an easy access to the machine panel and was able to enter or change the parameters.

Question 3: Why does everyone have easy access to the machine panel and was able to enter the parameters? Answer: There are no specially designated persons, with access to change of the parameters.

Question 4: Why have not been designated people who could change the parameters? Answer: Limitations related to access to the machine panel for enter the parameters were not implemented.

Question 5: Why were not introduced limitations related to access to machine panel to enter the parameters? Answer: Missing readers and GKN cards (These cards allow designated persons access to the control panel in order to change parameters).

Problem 3: Failure of pneumatic pliers.
Question 1: Why has failure of pneumatic pliers occurred? Answer: The pin on which were mounted pneumatic pliers was protruded.
Question 2: Why the pin for mounting pneumatic pliers was protruded? Answer: Missing protection.
Question 3: Why wasn't there protection? Answer: The protection was not founded on the pin.
Question 4: Why protection was not founded on the pin? Answer: Protection on the pin was not necessary.
Question 5: Why the protection on the pin was not necessary? Answer: It has never occurred before that pin protruded.

5. Conclusions

The study using method 5WHY confirmed in two cases the significance of two causes (incorrect position of the housing on the shaft and incorrect parameters of the band's fastening) that were found using Ishikawa diagram. Analysis carried out by 5WHY method has allowed the identification of additional cause (failure of pneumatic pliers). To eliminate this problem should be put a metal or plastic protection on the pin on which are mounted pneumatic pliers.

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