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NO FAULT FORWARD OF RANGE COUNTER SHAFT SUB ASSEMBLY

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ABSTRACT

Tractor transmission plays an important role in transferring power from engine to the driving wheels. One of major component of transmission system is range counter shaft. It transmits the power and motion to the rear wheels. Some parts are missing during the assembly of range counter shaft. The main objective of paper is to design NFF of Range counter shaft sub assembly. No Fault Forward (NFF) technology that provides exceptional quality in assembly operation. It will not allow the assembly to move to the next work station in the process until all assembly steps required at that station are completed according to specification. Profile plate and sensors are used for making NFF. NFF increases the quality and gives effective manufacturing. Rejection reduced by 45% after implementing this technique for the above problem.

I. INTRODUCTION

R.A.Didikov et.al [1] reported power distribution control in perspective wheeled tractor transmission. The prospects of mechanism application on the transport and transport technological wheeled vehicles are examined. In this transmissions of tractors, skid steering principles such functions carried out with steering drive mechanisms. It is preferable to reduce the corridor width, which is occupied by vehicle during turning. A.Yu. Dobrehkin et.al [2] explained Split transmission of tractor with automatic gear box. Split transmission allows the use of the main advantage of the hydrostatic transmission in achieving satisfactory efficiency of the power train as a whole. In such a transmission providing the branching of the power flow. The algorithm of combined use of branches is based on the conditions for obtaining power train COP, exceeding the COP Of HT. tractors with the HT in the composition of the split transmission takes market segment of agriculture machinery. This concept allows maximum use of available production of the manufacturer. Wakil Ahmed Syed et.al [3] presented Intermittent fault finding Strategies. Intermittent faults are regarded as the most difficult class of faults to diagnose and are cited as one of the main root causes of No Fault Found. The deployment of intermittent fault diagnostics is also of paramount importance in solving the phenomena known as No Fault Found (NFF). Traditionally, any product removal that exhibits no fault (during subsequent acceptance testing) can be categorised as NFF However, for a number of these events, further investigation could conclude that the reason for the product removal was caused by an external influence not present during testing of the removed system, these may include environmental effects, integration with other systems, damaged wiring or loose/damaged connections. It is commonly accepted that NFF phenomena arise from a minimum of two test levels. At any test level, a fault may be recognised and localised as belonging to an individual piece of equipment which, when re-tested, at a subsequent level, the recognition/localisation of the reported fault may be unsuccessful. NFF events pose problems to almost everyone that is involved with the product/vehicle/machine, from customers to manufacturers and their suppliers. The impact of NFF will range from mere nuisances, to increased financial costs through to risking safety. No Fault Found research, which include the prediction of NFF related faults through the use of nonlinear observers, the analysis of system stability and coupling using phase-space reconstruction. Dr.-Ing. Carl Hans et.al[4] reported NFF Special Session - Potentials of Applying Methods, Tools, Processes and Knowledge from Testing in Product Development to the NFF Problem. This paper investigates air craft Middle of Life (MOL) life cycle phase applied to the NFF problem in air craft. The testing process and method of tools applied are discussed. Mainly testing high-lift systems with different methods and software tools. Jhon Ahmet Erkoyuncu et.al [5] presented A framework to estimate the cost of No-Fault Found events. The article investigates a generic framework to estimate maintenance costs attributed to the No Fault Found

(NFF) phenomenon. By applying the soft systems methodology to capture the critical cost drivers of NFF across the supply chain and build a framework to estimate the cost of NFF. NFF corrective maintenance cost is much higher than the preventative costs. This requires further methods and techniques that can help to reduce the costs experienced. NFF preventative maintenance costs are less than corrective maintenance costs as expected. Chris Hockley et.al [6] reported A Research Study of no Fault Found (NFF) in the Royal Air Force. The No Fault Found (NFF) problem continues to reduce operational availability and have an impact on cost and resources in the RAF. A survey is conducted in the RAF that includs no.of faults identified, fault history and repeat arisings and human factor. Human factor issues were clearly an aver –arching reason for personal avoiding to declare NFF. The foregoing sections have summarized the conditions and the recommendations for the MOD which if applied would make significant impact on their NFF costs.

II. PROBLEM DEFNITION

There are some failures occurring during the assembly of range counter shaft. To avoid the problems that occur during the assembly NFF station is introduced. It helps in reducing the problems that are occur during assembly. No Fault Forward (NFF) is a technology that provides exceptional quality in assembly operation. It will not allow the assembly to move to the next work station in the process until all assembly steps required at that station are completed according to specification. Profile plate and sensors are used for making NFF. NFF increases the quality and gives effective manufacturing.

Table 1: Failures occur in range counter shaft

S. No	Component	Failure Category
1	Needle roller bearing	Missing
2	Ball chrome steel	missing
3	Spacer	Missing
4	Snap ring	Wrong position
5	Circlip	Loose
6	Adapter gear	Wrong orientation

One of the most missing component is needle roller bearing. A poka-yoke is introduced to reduce the failures occur by missing needle roller bearing

Poka-yoke for Needle roller bearing

A poka-yoke is any mechanism in a lean manufacturing process that helps an equipment operator avoid mistakes . Its purpose is to eliminate product defects by preventing, correcting, or drawing attention to human errors as they occur. Poka-yoke for needle roller bearing shown in fig 4.1 is bearing pressing machine. It presses the needle roller bearing into the hollow shaft. For this a sensor is placed that detects the roller bearing. The bearing is pressed only when the bearing is sensed.

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Fig .1 poka-yoke for needle roller bearing

Table 2: Total no. of failures observed 15th Jan 2018 – 15th Feb2018

S.no	component	Failure category	No. of failures occurred
1	Ball chrome steel	missing	11
2	Spacer	Missing	3
3	Snap ring	Wrong position	4
4	Circlip	Loose	7
5	Adapter gear	Wrong orientation	1

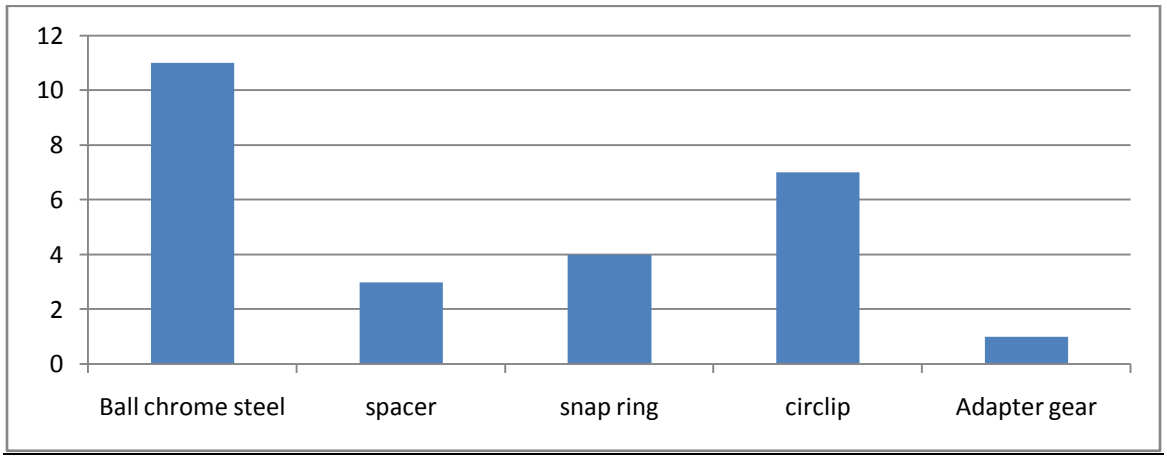

Fig 2 bar chart for no. of failures observed

From the observed conditions we can better to implement a technique that reduce failures occur in range counter shaft assembly. By introducing NFF technique will help in reducing failures occur in Range counter shaft sub assembly.

Cost analysis

The Average rework time per transmission system is 5-8 minutes. In 12 hours (2 shifts) it takes one and half hour to do the rework. As per the company norms, if we save one men power they will have Rs.100000 savings. Cost of each sensor is approximately Rs.2000. we need 5 sensors i.e.Rs.10000 and sensor tray, profile plate costs Rs.2500.Total cost Rs.12500.By doing this project i can reduce the men power that costs Rs.100000.This will be profit to the company.

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NFF of range counter shaft sub assembly

NFF stands for No Fault Forward. NFF is a technology that helps in zero defects in that respective assembly. It will not allow the assembly move to the next station in the process until all assembly steps required at that station are completed according to specification. No Fault Forward (NFF) control technology improves quality, improves assembly throughout and reduces warranty claims. It will improve the quality of assembly.

To avoid the failures that take place in range counter shaft sub assembly, NFF of range counter shaft is done. NFF (No Fault Forward) technology that provides exceptional quality in assembly operation. It will not allow the assembly to move to the next work station in the process until all assembly steps required at that station are completed according to specification. Profile plate and sensors are used for making NFF. NFF increases the quality and gives effective manufacturing.

Construction of NFF station

For this NFF station we need a sensor tray shown in fig6.1 that holds the components that comes under failure category. This sensor plate helps to sense the components that are missing, the components are placed in the sensor plate it detect the components and sensor plate is connected to the needle roller bearing pressing machine.

Fig 3 model sensor tray

Profile plate

And the other major need for the NFF station is profile plate. Profile plate shown in 6.2 is in which the sensors are embedded that detects all the components that present the profile plate is in the cross section of sub assembly. And this profile plate is connected to the poka-yoke of needle roller bearing.

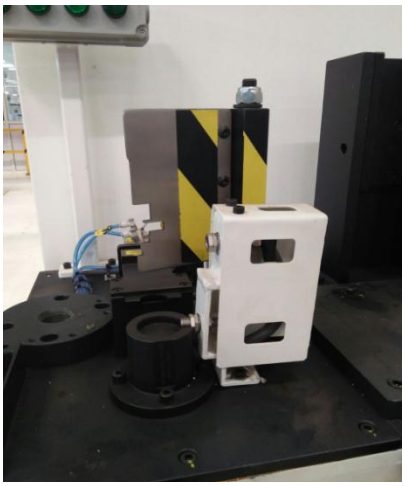

Fig 4 model profile plate

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Alarm is set in the station as shown in fig 6.3 that will give notification when a component misses in that assembly through sensors. The sensor plate and the profile plate connected to the needle roller bearing pressing machine. When no fault occur in the assembly then only the needle roller bearing is being pressed in the hollow counter shaft. Then the assembly goes to the further assembly without any failure.

Fig 5. construction of NFF station

Working of NFF station

In sensor tray 5 sensors are embedded that access for 5 failure parts these sensors are connected to the bearing pressing machine. Profile plate is a metallic plate which has the profile of the range counter shaft. When the assembly is checked in this profile plate when it is done. Then the profile plate is also connected to the bearing pressing machine. Then the assembly forwarded to the bearing pressing machine. If all the components present in the assembly then only the needle roller bearing is being pressed in to the hollow counter shaft. If any failure in the assembly shows the notification through alarm.

III. CONCLUSION

Production of transmission system per month is approximately 200 units. The rejection of transmission are 26 out of 200, as per the observation from 15th jan 2018 to 15th feb 2018. This rejection happend due to failures occur in range counter shaft sub assembly. Re-work for those 26 tractors approximately of 390 minutes. By introducing NFF station rejections are reduced completely caused by range counter shaft and the re-work time. Re-work cost for 390 minutes is approximately Rs.16,000 that can be reduced by introducing this station.

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