ISSN: 0975-833X

Available online at http://www.journalcra.com

International Journal of Current Research
Vol. 7, Issue, 03, pp.13872-13877, March, 2015

INTERNATIONAL JOURNAL OF CURRENT RESEARCH

RESEARCH ARTICLE

MATCHING RATE IMPROVEMENT ON PAKO

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ARTICLE INFO

Article History:
Received 24th December, 2014
Received in revised form
26th January, 2015
Accepted 28th February, 2015
Published online 31st March, 2015

Key words:

Nozzle body, Needle class,
Clearance, Matching rate.

ABSTRACT

PAKO is German machinery on which we pair nozzle body with required needle class, so that we can adjust the required clearance. Our project on PAKO is related to the improvement in clearance to increase the Matching rate. It is found that, in today's condition Matching rate is about 60-65% and our aim is to improve it. We have to find out factors affecting matching rate as per their priority of impact and find out ways of improvement of Matching rate. So by taking no. of readings on different benches /machines with one as group of sample parts. We compare it with another readings and we find changes while pairing.

INTRODUCTION

In all there are various operations are performed on nozzle body and needle before it is being dispatched for commercial use. One of such operation is the pairing of nozzle body and needle. This operation is done for improvement of matching rate of nozzle. But there is a major difference in the actual production rate and the planned production. So the basic criteria for this project is to find out these problems and to come out with solutions that might help in increasing the production rate. For this purpose a complete study of all the machine elements is the basic need of this project. For finding out the basic hindrances a complete study and detailed observation is done. Daily reports is formulated and the major aspects is calculated. These activities is done on a daily basis and then after sufficient amount of data is available the conclusions is drafted for solving these problems. Another major aspect of this project is to improve the performance of these machines. Thus is another side of the same coin and would be automatically attained if the major problems is solved and then machine would run and produce parts to its full capacity. For this daily commissioning of this machine is done. Commissioning being a big term is the major title of this project which had all the possible measures to improve the overall equipment effectiveness of the machine. This project aim at improving the overall effectiveness of the machine and finding out the major problems that hamper the rate of production and to come out with solutions that might help in improving the production rate of the machine. As we are working in PAKO department, PAKO is a newly established department. There are six PAKO benches and two NAKO benches. These machines are fully automated with nozzle body and needle pairing result on screen. During pairing when we insert nozzle body, on the screen shows dimensions of the nozzle body as well as needle required for pairing. For pairing it shows class of needle required. Needle is divided into total 20 classes. Each class contains 80 needles .Class one contains needle from 3.9965-3.9969 to class 20 of 4.0060-4.0064. In each class there is 0.4 micron difference.

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Types of Nozzles

DN nozzles

These are the pintle type nozzles. Pintle-type nozzles have a coaxial jet and are used in pre-combustion chamber engines and turbulent chamber engines. The nozzle opening pressures it between 115 and 400 bar.

Fig. 1. DN nozzles

Orifice Nozzles

These Orifice nozzles or Pintaux nozzle have several Spray orifices and are required for engines with direct injection (www.spray.com [Accessed on 11-01-2015]). The nozzle opening pressure is between 180 and 400 bar. For larger engines (more than 75 kW) also cooled nozzles are used (Gerald Hagemann *et al*., 1998). These are termed as: DL, DLL, DSLA etc. these types are orifice types of nozzles but the difference in them is the shaft diameter and length of the collar.

Fig. 2. Orifice Nozzles

Company is market leader in fuel injectors used in automobile industry (Jet nozzles, Type DUK 2103). Fuel injector is heart of engine as it sprays the fuel into the combustion cylinder. It consists of cylindrical and internally hollow body through which a needle is passed that is held by means of spring against nozzle at bottom of the body. It has inlet bore for diesel at inclination to the body of injector which enters the hollow section of the body.

The nozzle consists of stepped cylinder and needle pin. The stepped cylinder known as nozzle body, is manufactured in soft and hard stages (Robert "Bobby" Grisso *et al.,* 2013). The needle is manufactured in the needle hard stage. The assembly stage combines both these parts into nozzle assembly. Functional parameters of nozzle body are the inlet hole, spray holes and guide bore (Monte P. Johnso *et al*., 1914). Precision requirements of these parameters are in microns. Needle is fitted into the guide bore, where the step of the pin coincides with the pressure chamber. The pin is held into the injector assembly by means of spring at rest, the pin is resting on the sack hole of the nozzle.

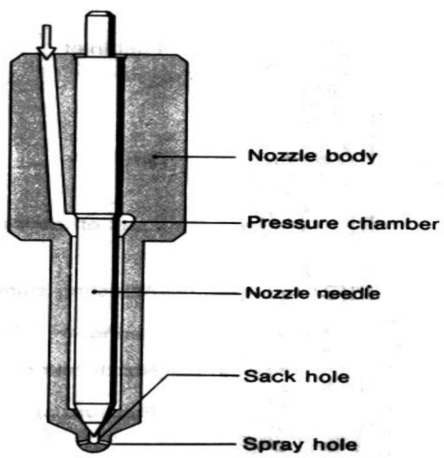

Fig. 3. Nozzle body

When the fuel enters the nozzle body through inlet hole, its pressure is high than the force at which the pin is held by the spring in rest position. This difference in pressure causes the pin to rise and the fuel gets sprayed through spray holes on the external periphery of the seat (Dipak J. Choudhar *et al.,* 2012). When the flow through the inlet stops, the impact of the pin causes to atomization of the fuel through the spray holes. This flow of the fuel through spray holes is known as Hydraulic through flow (HTF).

PAKO

It is German machinery which is used for pairing nozzle body & needle by showing whether pairing is ok or not ok.

Operation type

1) Manual
2) Automatic
Parts in System
IN stand - 4 trays Max
In process - 1 tray Max
OUT stand - 4 trays Max
One tray = 50 part

Working process

1. Take body from tray on Table
2. Put the body in measuring station
3. See body form and Check whether it's ok
Or NOK for body delta.
4. Put the body in waiting block.
5. Take needle from defined class (of which green light is glowing) needle tray.
6. Put needle measuring station.
7. Put new body in measuring station.
8. Measurement of Assembly see if Ok or NOK.
9. If measurement is NOK put the needle if measurement is NOK pick and put back into tray from which it is lifted second needle
10. Measurement of Assembly see if Ok or NOK
11. If measurement is NOK put the needle if measurement is NOK pick and put back into tray from which it is lifted third needle
12. Measurement of Assembly see if Ok or NOK.
13. If measurement is NOK lift the body from If measurement is NOK put the needle
The waiting block and put into quarantine back into tray from which it is lifted.
14. Take a body from the measuring station If measurement is OK take a needle and To waiting block body from the waiting block.
15. Take body from tray on Table.
16. Put the body in measuring station. Take needle from defined class (of which
Green light is glowing) needle tray
17. Assemble the body and the needle.

Some Definitions

Body delta = $|$ Dmax - Dmin $|$

It is the determinant of Dmax-Dmin.
Dmax –Max. distance between inner body & center line.
Dmin – Minimum distance between inner body & center line.

Body Form = Dmax - Dmin
Dmax –Max. distance between tangent at inner body & center line.
Dmin – Minimum distance between tangent at inner body & center line

Dimensions

Dimension shown on screen of PAKO are in German language, conversion of them in universal language is as follows :
M1 – Body D-min - minimum diameter of body approx..4mm
M2 – Body Delta - │Dmax - Dmin│
M3 – Needle Delta - Dmax - Dmin
M4 – Needle dimension – dimension of needle shown on screen.
M5 – FSP eff. Bottom – clearance bet^n body & needle at bottom(um).
M6 – FSP eff. Middle - clearance bet^n body & needle at mid(um).
M7 – FSP eff. Top - clearance bet^n body & needle at top(um).
M8 – Required needle – needle type required for pairing.
M9 – Body length -
M10 – Needle length
M11 – Body form **M12** – Needle form.

Matching Rate

"It is the ratio of number Of ok parts to the number of cycles completed.

M.R. = No. Of ok parts / No. Of cycles completed .

Objective of matching rate improvement

1. Improvement of M.R. helps in reducing cycle time.
2. Increases productivity.
3. It reduces downtime of nozzle.

In regular pairing of nozzle & needle we have to perform some regular activity which affects performance of benches as shown below

Stability

Before pairing, care should be taken that machine should be well stabilized. In stability measurement we stabilize the m\c by using master. Stability is measured after per two hour.

Calibration

Before pairing, care should be taken that machine should be well calibrated. Calibration is taken after per four hour

Parameter to check

1. Master diameter outside small 3. Master diameter inside small
2. Master diameter outside big 4. Master diameter inside big
3. Converter connection voltage.
While pairing needle and nozzle on PAKO bench sometime they do not match due to following reason causes rejection

Rejection Types

Rejection

1.Zero class
2.Taper
3.No match
4.No needle

Zero class

When body required needle dimension is more than 4.0087 & less than 3.9988.

Types of Zero Class

Zero class

1.Over size
2.Under size
3.Form bad
4.Delta bad

Process flow

After separating zero class body, they goes through following stages

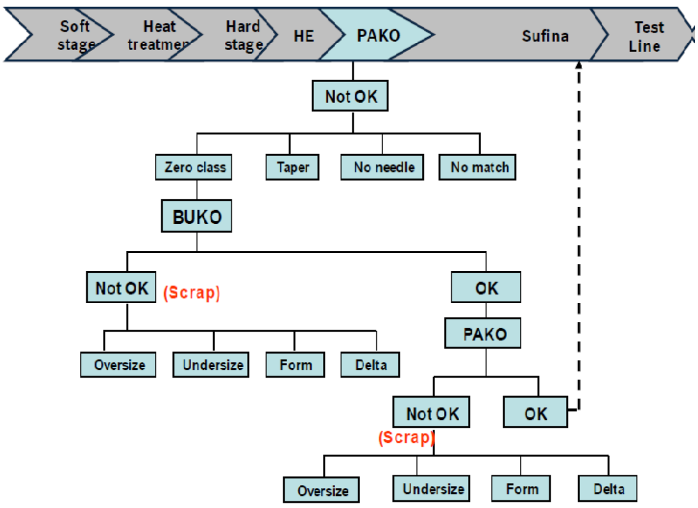

Fig. 4. Process flow after PAKO for zero class

After separating taper body, they goes through following stages

Factor affecting to the improvement of matching rate

1. Needle mix-up
2. Needle delta bad
3. Change in Matching Rate due to Bath change
4. Inlet hole position
5. Burr at top surface

6. Taper body
7. Zero class
8. Not availability of needle
9. Dust
10. Stability bad (variation)

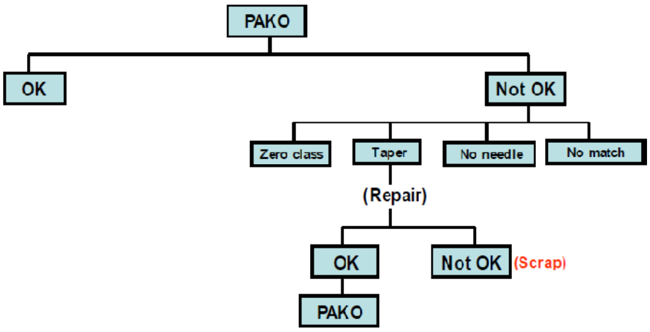

Fig. 5. Process flow after PAKO for taper

Activity

Needle Mixing

Procedure

1.Check same needle on PAKO as well as on NAKO.
2. Find out variation in dimension & plot graph of variation whether change in limit.

NAKO	PAKO
4.0024	4.0025
4.0042	4.0042
4.0012	4.0012
4.0009	4.0008
4.0022	4.0022
4.002	4.0019
3.991	3.9991
4.0021	4.0019
4.001	4.0011
4.0026	4.0026

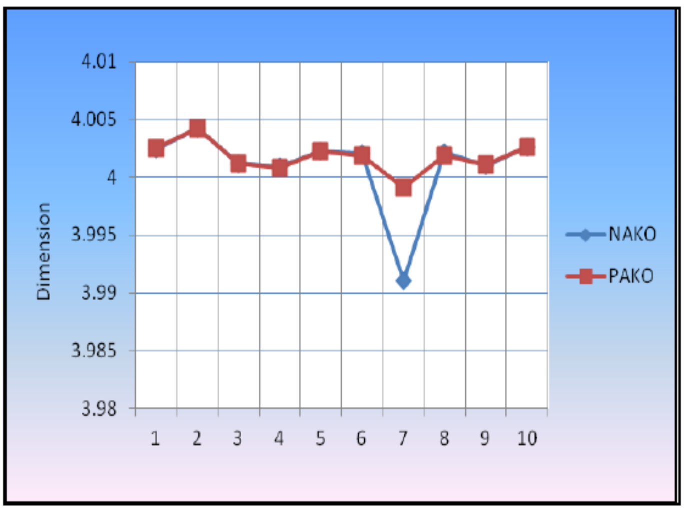

Fig. 6. Comparative analysis of needle mixing on NAKO and PAKO

Causes of needle mix up

1) Varying air pressure & vacuum.
2) Warm out of ring gauge.
3) Conversion setting is not okay.
4) Cleaning of ring gauge ,frequently is not followed

Activity

Variation in Pressure value.

Procedure

1.Check nozzle body on bench no.437 requires following needles.
2. Note the pressure at which it is operated.
3.Check it again on same bench ,note change in needle dimension with variation in needle dimension

Sr.no.	Pressure value - 1	First check	Sec.check	Pressure value-2
1	3.05	4.0024	4.003	3.06
2	2.99	4.0026	4.0025	3.05
3	3	4.0022	4.002	3.02
4	3.02	4.0008	4.0012	3.05
5	3.04	4.0003	4.0005	3.06
6	3.05	4.0019	4.002	3.08
7	3.02	4.0028	4.0025	3.03
8	3.01	4.0017	4.002	2.99
9	3	4.0014	4.0015	3.04
10	2.99	4.001	4.0012	3.02

Fig. 7. Variation in Pressure value after subsequent check

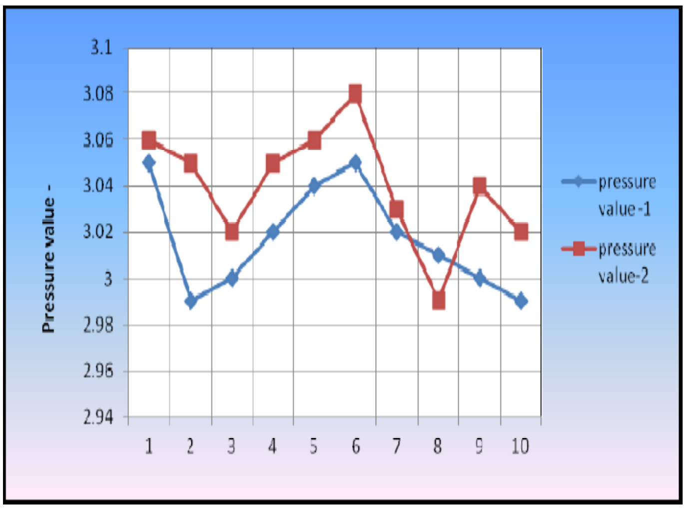

Fig. 8. Variation in Pressure

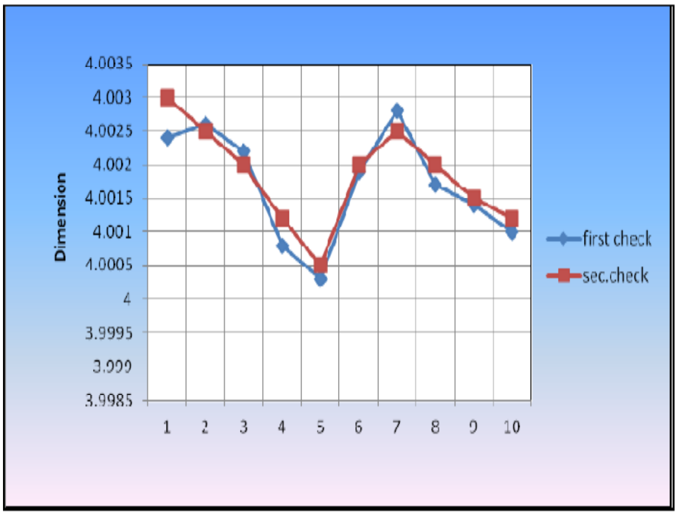

Fig. 9. Variation in needle dimensions

Activity

Cleaning event

From trial 1

It has been observed that matching rate before cleaning was 66.45 but after cleaning it increase upto 76.56 i.e. of 10% increment in matching rate occurs. After cleaning it increase to 78.84, after some time it get reduces.

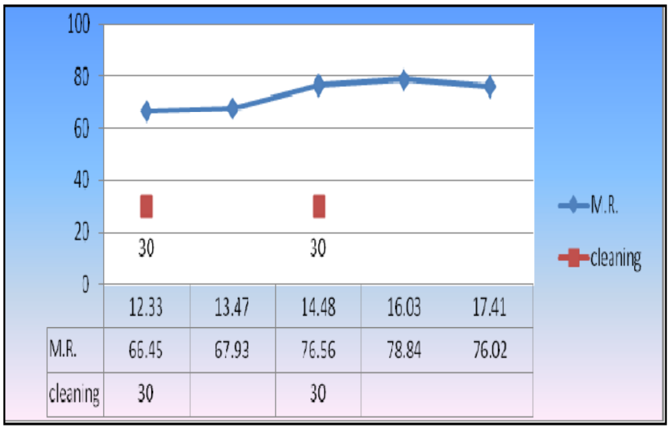

Fig. 10. Effect of cleaning on needle matching rate (Trail 1)

Conclusion

After cleaning process matching rate increases instantly.

From trial 2

Matching rate before cleaning was 43 after cleaning it increases upto 62.69 to 77.27 i.e. of 34.27% increment in matching rate occurs., after some time it get reduces.

Conclusion

After cleaning process Matching rate increases suddenly but after some period it get decreases

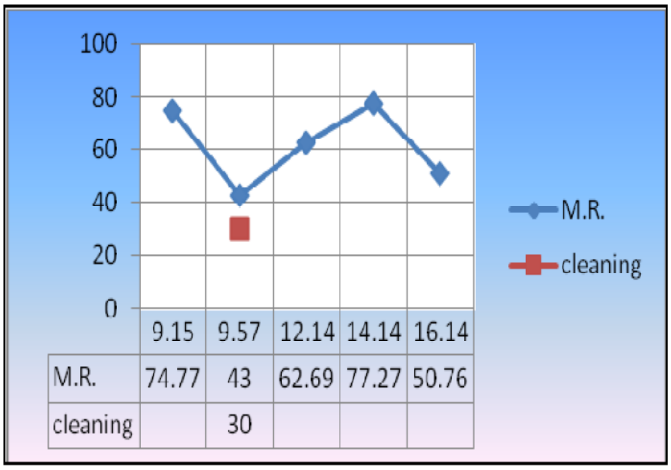

Fig. 11. Effect of cleaning on needle matching rate (Trail 2)

From trial 3

Matching rate before cleaning was 65.47 ,after cleaning it it increase from 65.04 to 84.21 i.e. of 19.17% increment in matching rate occurs., after some time it get reduces.

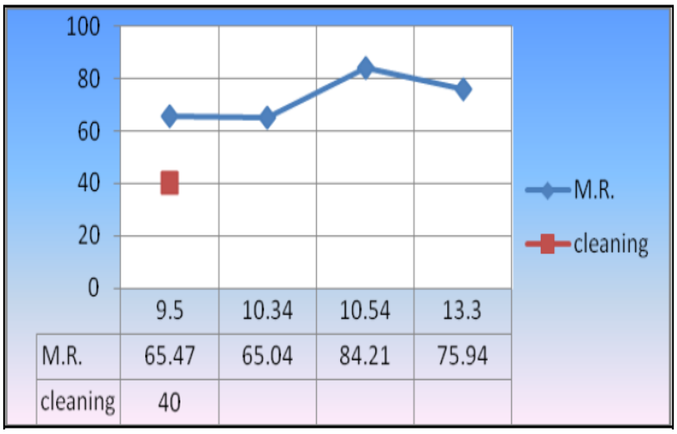

Fig. 12. Effect of cleaning on needle matching rate (Trail 3)

Conclusion

After cleaning process matching rate increases constantly then increases suddenly.

Conclusion

It is very clear from the above findings that there is some problems in the machining rate which is adversely affecting the productivity rate of the machine. So these problems is solved and the changes in the production level is found out. By rectifying all the basic problems regarding pairing and also in the machining procedure the final aim of attaining maximum matching rate is attained. The basic aim of this project is to improve the matching rate of the PAKO bench. For this work to be performed the major hindrances to the factors affecting to the matching rate like needle mix-up, pressure variation, PAKO monitoring, need to be solved. In the step to analyse the project each and every problem is dealt with and then final solution of attaining improved matching rate is found out by cleaning event. The percentage of improvement is considerable from above trials like cleaning event and it is on the track of improvement. There are still many problems in the machine which are still to be solved. So there is still future scope to improve the matching rate of machine and production rate.

Scope of the project

It is necessary that for any vehicle to give better performance with an average speed; nozzle should work with better efficiency. For it pairing of nozzle body and needle should be done accurately; it should be done within given range. Generally it is in range of 50-65 percentage, in form of matching rate in PAKO. But it is not sufficient. We have to increase it. The problems like needle mix up, inlet hole burr, taper parts affect matching rate.

Also to check whether matching rate changes due to bath change, mandrel cleanup, since due to needle form & delta less than 0.8 affects pairing rate or not ,we have to find out reasons of change in matching rate per shift or to the per bench, & to suggest solution for it.

REFERENCES

"Jet nozzles, Type DUK" from TROX company, retrieved 15th October 2013 from http://www.troxaustralia.com/xpool/download/en/technical_documents/diffusers/leaflets/t_1_2_2_duk.pdf

Dipak J. Choudhar *et al.* Efficiency Analysis of an Aerospike Nozzle. International Journal of Engineering Res earch and Applications (IJERA) ISSN: 2248- 9622

Gerald Hagemann *et al.* Advanced Rocket Nozzles. Journal of propulsion and power, Vol. 14, No. 5, Sept. – Oct. 1998.

Monte P. Johnso *et al.* 1914. Cooperative extension service, University of Kentuki. Issued 8-92; Revised/Printed 3-96

National Conference on Emerging Trends in Engineering and Technology (VNCET - 30 Mar'12)

Robert "Bobby" Grisso *et al.* 2013. Nozzles: Selection and Sizing, Publication 442-032.

www.spray.com

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