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OEE improvement in LA2413 RF induction hardening machine

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Gudide by Kasiwishavanadhan

ABSTRACT

Induction hardening in a case hardening process in which we can harden selective portion of the component or material. Advantage of this process in it suitable for production of components of similar configuration or geometry hardened layer produced in this process is called as case depth. Hardness of this case depth varies depending upon the types of material used.

The components are heated by using high frequency electric current which sets up & subsequently hardness Induced eddy current heat the surface of the steel very quickly and are quickly followed by jets of water to quench the component. A level layer of case depth is produced with soft core. (Inner position of the material).

Case hardness is measured only in HRC machines or Vickers hardness testing machine. Induction hardening process is widely applied automobile component.

Normally induction hardening machines are classified as low frequency medium frequency and High frequency based on the frequency output from the machines. Components hardened are flange coupling, shift shaft, idler shaft etc..., Method of induction hardening is enveloped for EN8, CK45, S48C, EN18, EN19, materials etc...,

Objective

To meet the increased demand of induction hardening components by 52% in LA2413 with one shift operation by studying & Optimising OEE.(Overall Equipment Equipments).

INTRODUCTION

The purpose of project is to describe a method developed for reducing setup time in machining processes and simultaneously improve the quality of production after setup. Ashok Leyland is automated plant producing high performing diesel engines & Vehicles for domestic as well as international market. Setup time at different machining centres includes machining time, inspection time, loading and unloading time.

The focus of the described method is in reducing setup time related to inspection time and loading and unloading times. To achieve success in these problems the following new tools were developed: first piece inspection charts, design fixture and design of new handling tools. This work involved interaction with operation, collection of data and analysing and developing new plans based on the analysis. Tools like Failure Modes Effects Analysis (FMEA), 5S and Single Minute Exchange of Die (SMED).

In this method used to improvement the overall equipment effectiveness 51.89% to 79.42%. To reduce the setting time and inspection time. They are three types flange coupling to be machined hardening process such as shift shaft, shaft idler and oil seal ring. Also the quality improvement techniques setup time reduction techniques used and Ashok Leyland are discussed in this project.

Problem statement

- Unable to meet the increased demand in LA2413 with one shift operation.

Author for correspondence:

- Only give a standard time for 171 hours per month but requirement times 230 hours per month. Shortfall hours are 59 hours per month.
- Thought of operation night shift by adding a man power.
- Adding man power will increase the cost.
- Inspection time is very high.
- It required the two members on the inspection of the material.

Major loss contributors

- Setting / change time
- Inspection time

Operator only on day shift (Table 4.1)

S.NO	MACHINE	STANDARD TIME (Hours)
1	2413(RF-GEC)	171
2	4674(EMA-OLD)	171
3	9077(EMA-NEW)	171
	TOTAL	513

REQUIREMENT **VS** STANDARD
230Hrs/month 171hrs/month

Excess inspection time

- Difficult to hold and check the hardness on the hardened surface due to is geometry, heavy weight unbalancing during.
- Two persons are involved to check hardness (fig 4.1)
- Hardness to be checked one in two pieces.
- Hardness to check in three locations.

Difficult to check hardness (Fig 4.1)

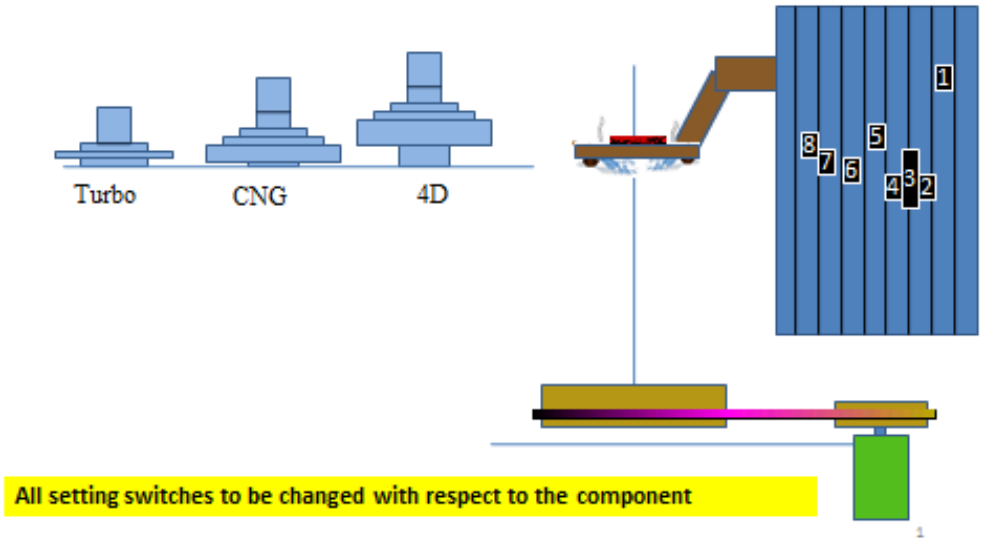
Problem analysis

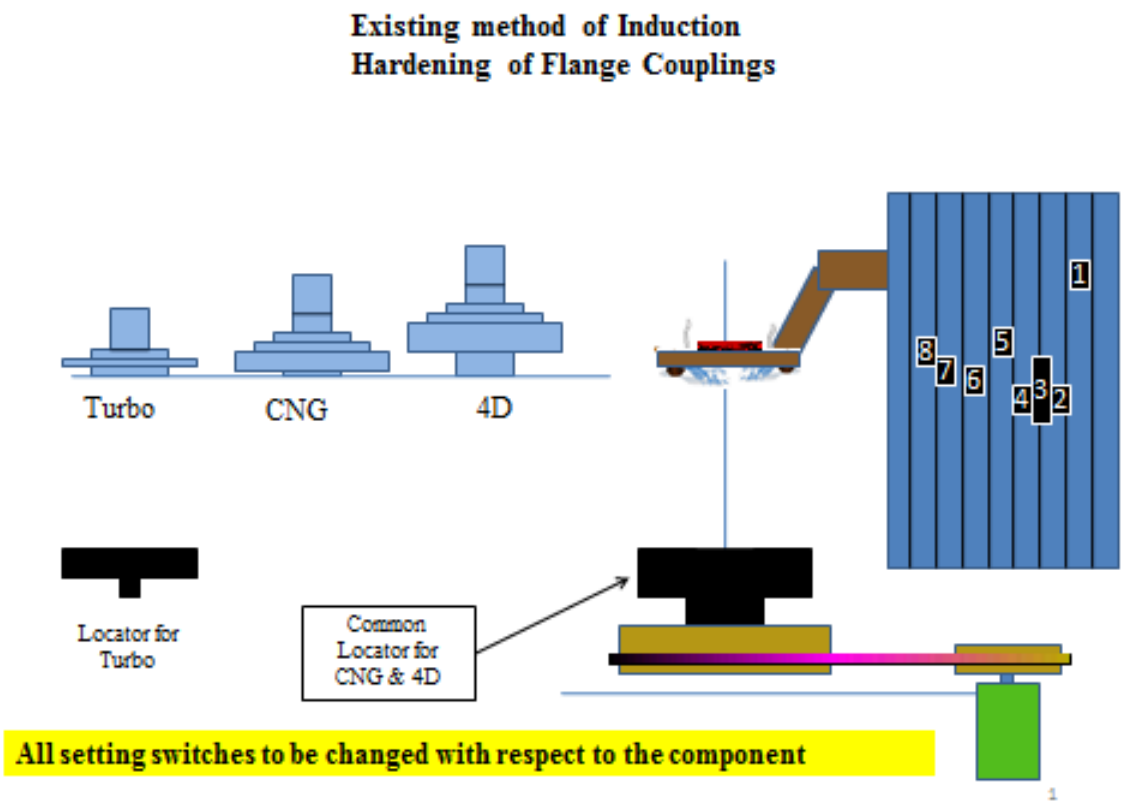
- More Setting time
- Different Components

- Repeated change of Settings
- Changeover / Setting time high
- First off inspection time high
- Low Batch Qty
- Poor Load Distribution
- Manual Setting

More number of setting **x** Excess change over time = Total setting time high

Existing method of Induction Hardening of Flange Couplings





Machine	Component	Qty	Cycle Time	Total Hours	Setting / Change over time	No. of settings	Total Setting Time	Other Losses	Total Hours
LA 2413	4D Flange coupling	3600	1.8	108.00	3.2	10	32	42.33	230
	Turbo Flange Coupling	150	1.6	4.00	3.2	2	6.4		
	CNG Flange Coupling	150	1.7	4.25	3.2	4	12.8		
	Spindle	300	1	5.00	1	2	2		
	Cam shaft	50	4.8	4.00	1	2	2		
	Total			125.25			**55.20**	42.33	
LA 4674	Shaft Idler	5300	1.5	132.50	1.8	1	1.8	32.4	166.70
LA9077	Shift shaft	1600	3.6	96.00	1.8	4	7.2	18.08	147.41
	Marine fork	100	4.8	8.00	1	2	2		
	Oil Seal Ring	400	2	13.33	1.4	2	2.8		
	Total			117.33			12.00	18.08	

Data analysis-total setting time high (table 4.2)

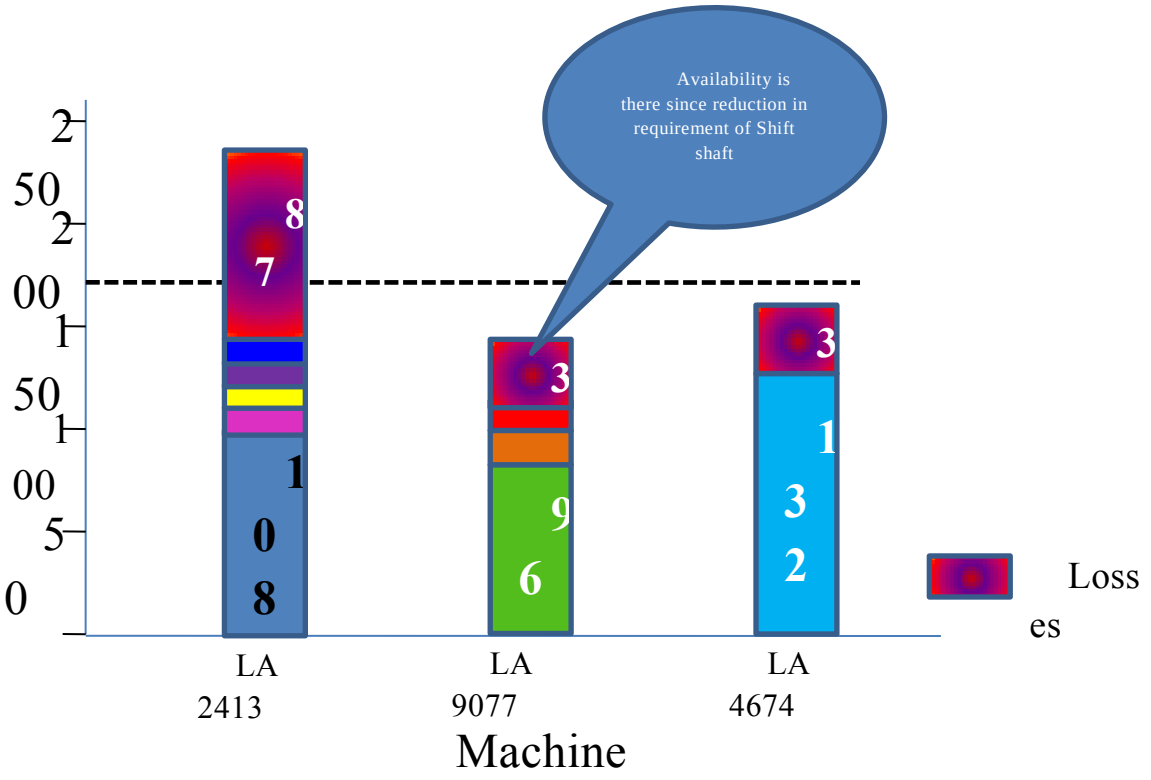
Machine	Component	Qty	Inspection Time	Total Inspection time
2413	**4D Flange coupling**	**3600**	**4.5**	**13.50**
	Turbo Flange Coupling	**150**	**1**	**0.13**
	CNG Flange Coupling	**150**	**4.5**	**0.56**
	Spindle	**300**	**0.5**	**0.13**
	Cam shaft	**50**	**0.5**	**0.02**
LA 4674	**Shaft Idler**	**5300**	**1**	**4.42**
9077	**Shift shaft**	**2000**	**1.67**	**2.78**
	Marine fork	**100**	**0.08**	**0.01**
	Oil Seal Ring	**200**	**0.33**	**0.06**

Data analysis- inspection time (table4.3)

Development ofsolution

- To use the locators and reduce the setting time
- To use the counter balance and reduce inspection time.

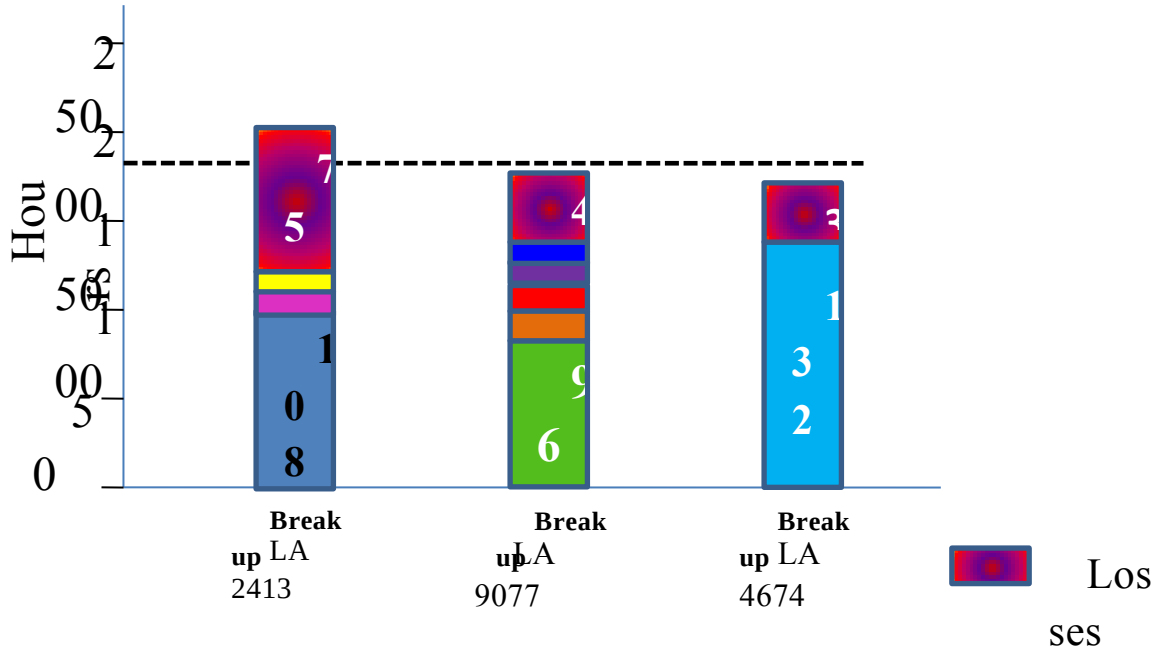
Load distribution



Some load shall be shifted to LA 9077

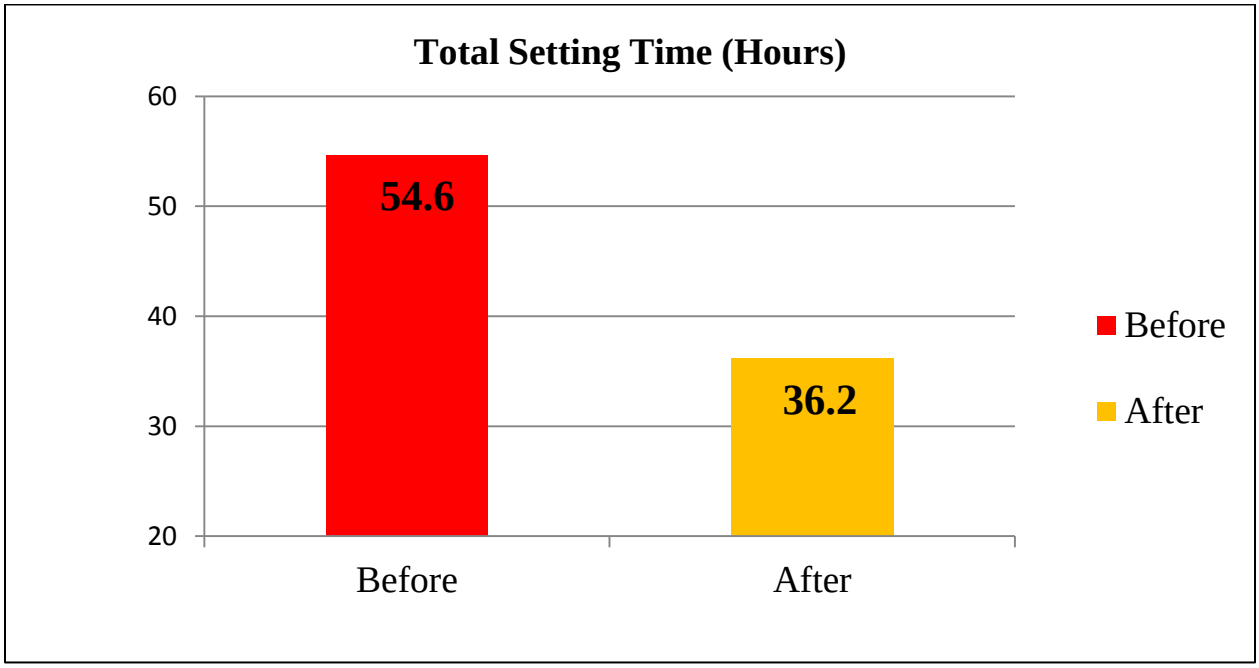
Based on following points we re-distributed the load

- Runner and stranger models the load has been redistributed.
- Common coil for different components which will reduce the coil replacing time.



Camshaft and spindle shifted to LA 9077 IH M/C

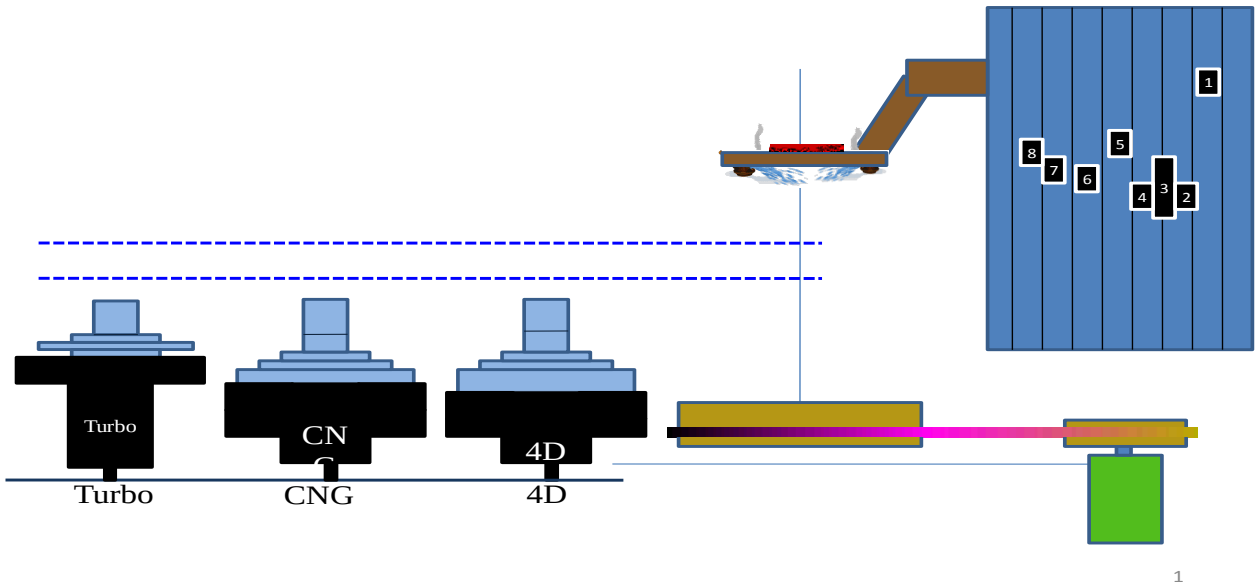
- Change in the load setting time after shifting cam shaft and spindle to LA9077



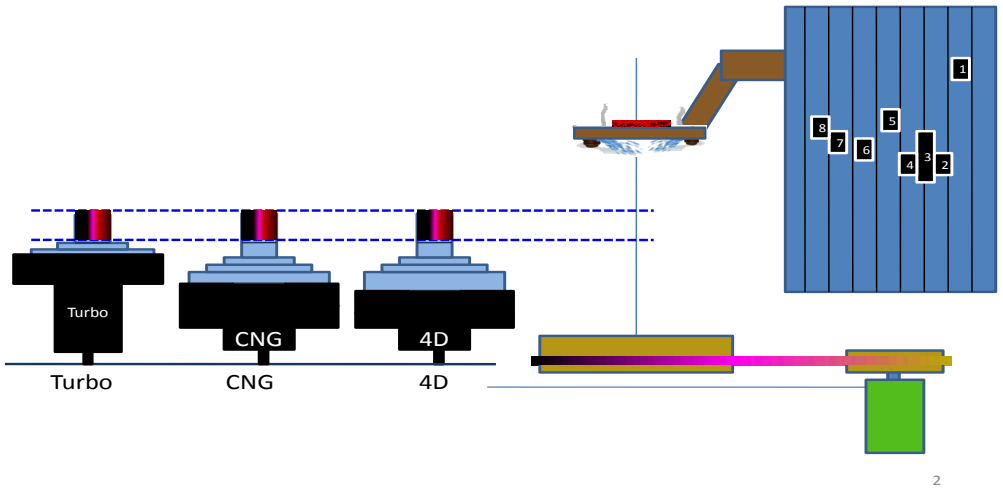
Total setting time has come down from (54.2 hrs- 36.2hrs)

Locators

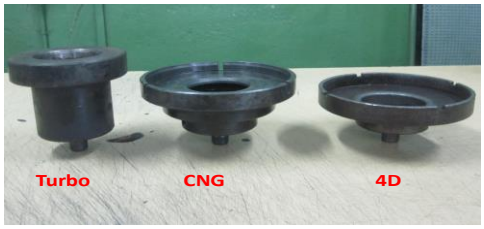
- Necessary dimension has been measured and drawing made for CNG and Turbo flange coupling.
- We order and got the newly developed locators.
- Different locators designed such that in the same reference all flange coupling heating zone align.

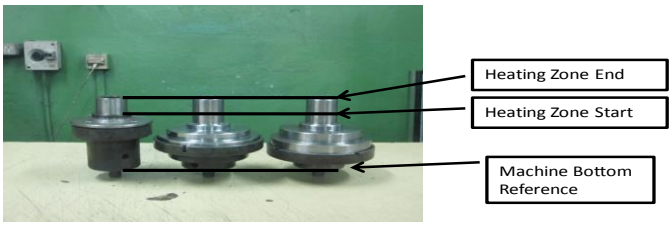


Existing method of change



Existing method of change





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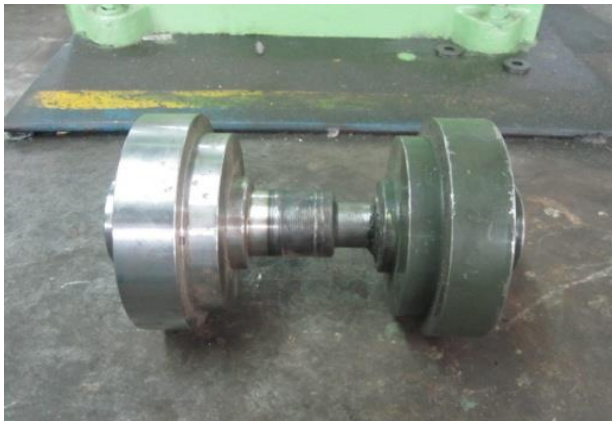
Different locators machined made ready for 3 flange coupling

LOCATORS **FLANGE COUPLING**

Inspection time

- To design the counter balance& manufacture the same
- To insert in the flange coupling
- To assemble Flange coupling & counter balance & kept on hardness testing machine for hardness testing.
- Finally very easy to check the hardness which can be done in 1min.

Counter balance designed



Counter balance inserted in the flange coupling

Assembly kept on hardness testing machine

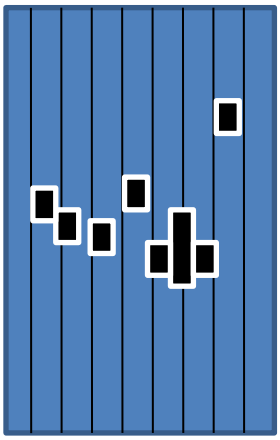
Very easy to check hardness can be done in 1 min

Flow chart-setting of induction hardening

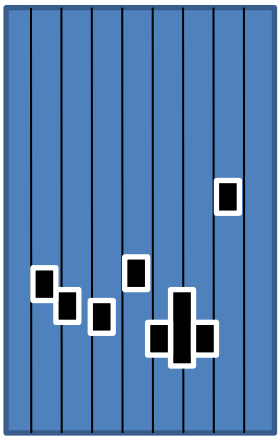
Fix the specified coil
↓
Fix the specified locator
↓
Align the coil
↓
Set the switches
↓
Adjust the parameters and trial run
↓
First off sample checking by destructive testing
↓
Sample crack detection
↓
Clearance for production

Ideas

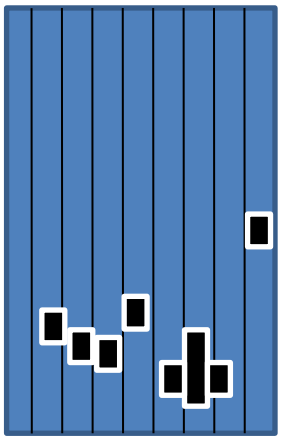
Changing the setting board by keeping different board for different component.



4D



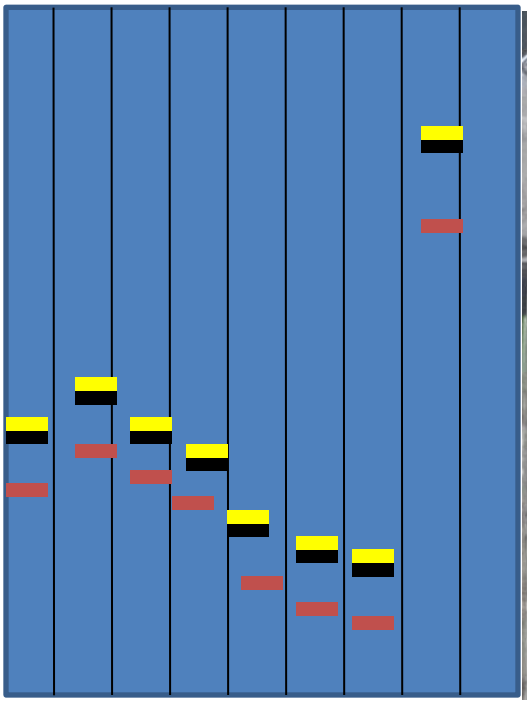
CNG

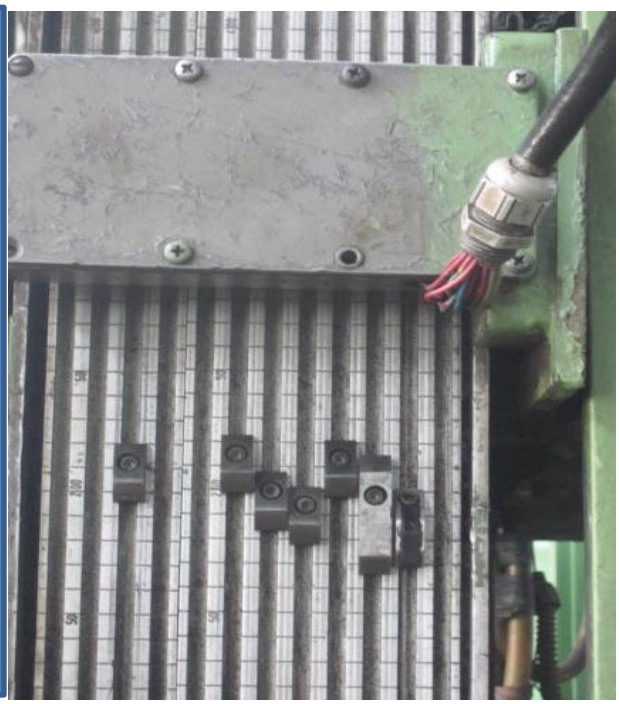


TURBO

- Machine modification required and investment.
- (CNG and turbo – monthly requirement is 150, that too supplied a batches of 50No's / batch.
- Not suitable for low volume batch.

- **Doing different colour markings on the board so that the switches shall be set easily.**



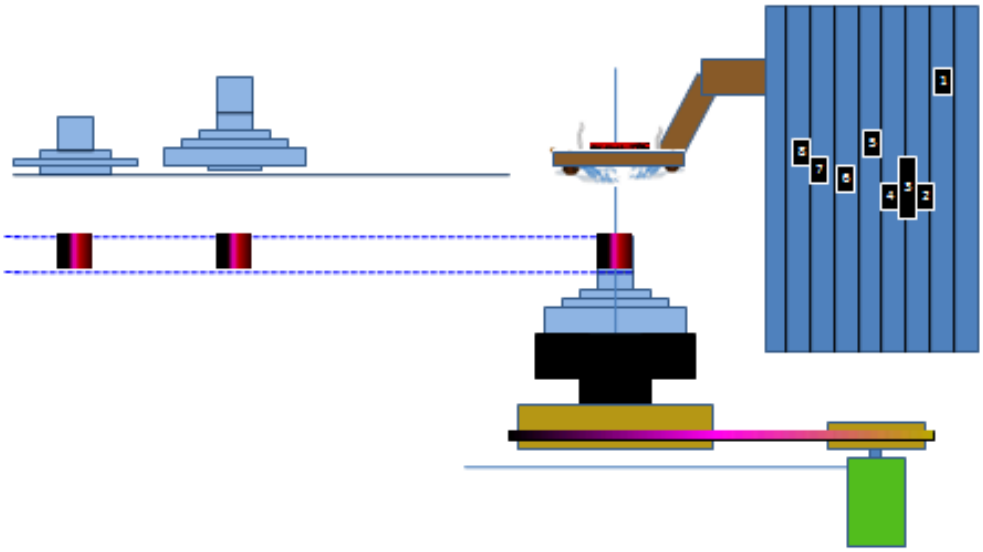


Mark the point

- As frequently we are changing the switch setting, mark points get erased.

- **Check for same band of heating zone and bring to the same reference point, do in a same setting.**

  - Aligning the heating zones to the same reference point.
  - Exploring the possibilities to do in the same setting.
  -



S.NO	IDEA	REMARK
1	Adjustable	Difficult to incorporate in the setup.
2	Using spacers and raise the locater to the required height.	Multiple pieces and error in individual pieces in increased effect.
3	Different locators for individual components.	Good idea.

Further improvement

- After taking for the major contributors
  - Setting time
  - Inspection time
- We have checked for others losses for improvement, but no scope was there.
- We checked for the possibility of process improvement (cycle reduction)

Ideas for improving the process

- Multiple pieces loading shall be explored

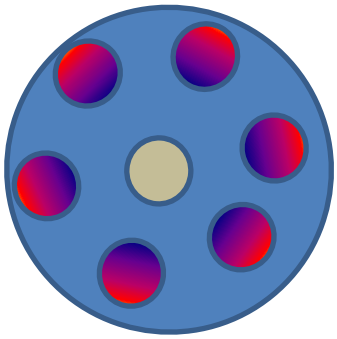
PARAMETERS	FEASIBILITY
Power adjustment	No further scope
Coil change elimination	No further scope
Multiple pieces distance	**Possibility is there**

Top position distance	No further scope

TRIAL

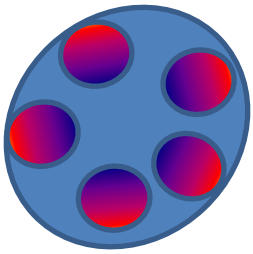
Multiple pieces loading

Use the seven pieces heat not penetrated to the centre piece. Coil facing pieces only got the required temperature.



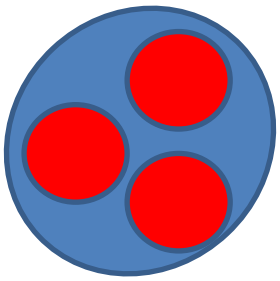
Trial-1

Use the five pieces still the dissipation of heat is not uniform.



Trial-2

Tried with three numbers. Result found satisfactory.

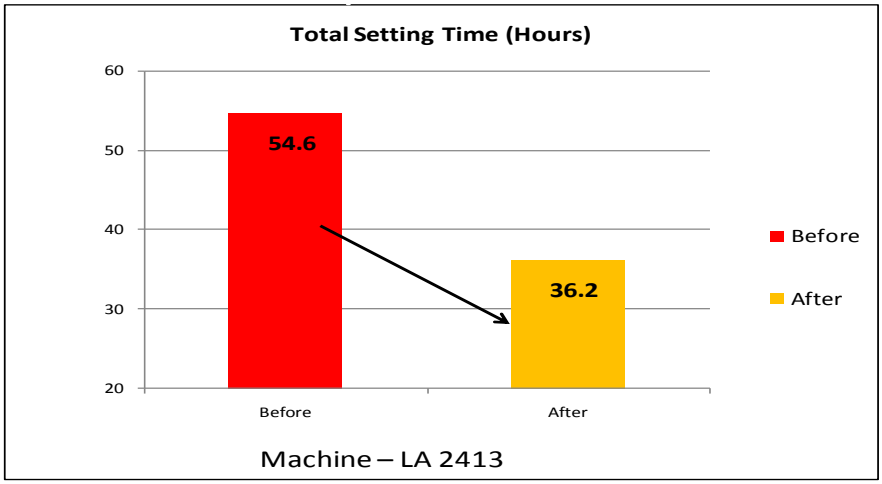


Trial -3

IMPLEMENTATION

Flange coupling & spindle

- Stared using the new locator from 28.09.16 onwards. Frequented check carried out.
- Checked for pattern for 3 month on every change of component.
- The results are satisfactory.



Total Setting Time has come down from 54.2 Hours to 36.2 Hours

20

Before

Difficult to Check Hardness. 2 persons required and took 5 minutes.

After

Very Easy to Check Hardness. Can be done in 1 min

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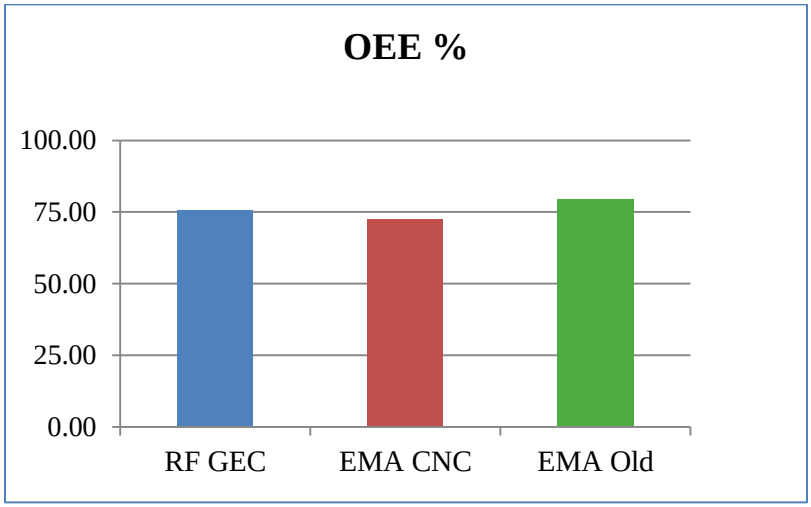
Inspection of flange coupling

OEE ANALYSIS

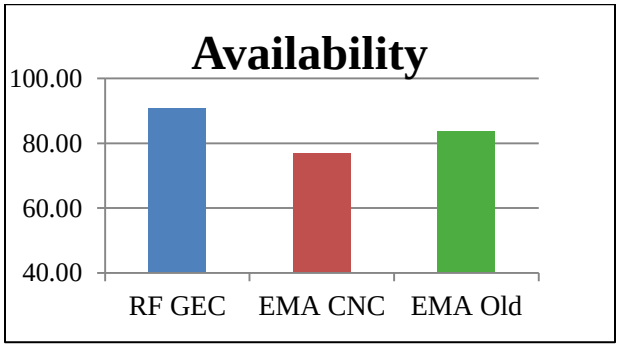
OEE improvement in LA2413 RF induction hardening machine.

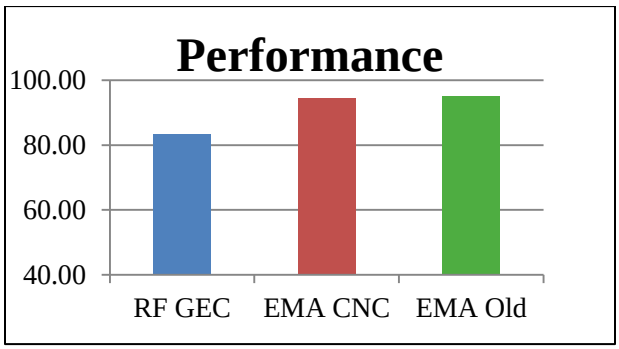
After the project

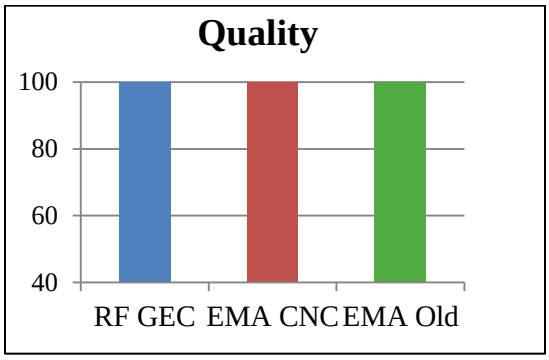


Machine	Availability	Performance	Quality	OEE %
RF GEC	**90.62**	**83.40**	**100**	**75.58**
EMA CNC	**76.80**	**94.45**	**100**	**72.54**
EMA Old	**83.6**	**95**	**100**	**79.42**

(OEE improved from 51.89 to 75.58)

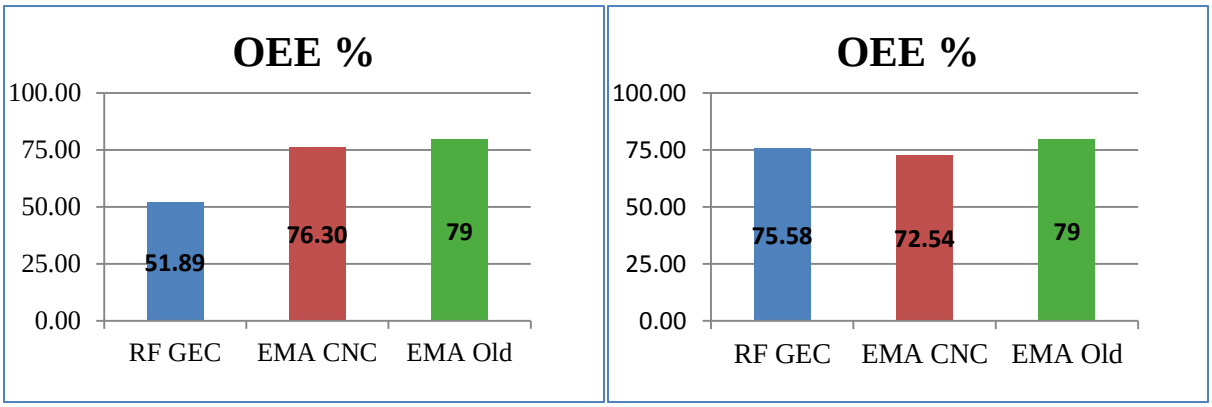






COMPARSION

After the project, overall equipment effectiveness of the machine improved. (OEE improved from 51.89 to 75.58%)



BEFORE **AFTER**

Benefits of improvement

- Recurring Savings of Rs.3.60 Lacks / Annum by optimum
- Utilization of available resources.
- Avoided the penalty payment, which we should havepaid, if the component is not delivered on time (VFJ Items)
- Average 12 No's Flange coupling /Month destructive testing avoided
- Activity De-skilled

Intangible benefits

- Employ moral improvement.
- Schedule adherence drastically improvement to the max.
- Team spirit improved by achieving the target.
- Avoided waiting and idle time.
- Improved the customer satisfaction.

Standarisation

As part of the improvement project for the following locators / tool diagram `have been made & tool colds have been allotted, as shown below.

- Drawing for the newly developed locators.
- Drawing no; 202WE2640, 41,42 – Date 29/01/17
- WIS updated
- WIS NO.HT/IH/003/16-17/ Date 29/01/17

- Concerned associates trained.

CONCLUSION

On completion of this project setup time in RF machine has been elastically reduced by 36.2 hrs per month and OEE (overall equipment effectiveness) has improvement from 51.89 to 75.58% and for flange coupling reduced to "zero" with available resources and existing man power, higher machine utilization is achieved. Overall benefit to the company in terms financial benefits can be achieved up to RS3.6 lacks per annum with this small improvement. This has improvement the moral of the employees in heat treatment shop.