ZF WABCO

Commercial Vehicle Control Systems

ZF Group - WABCO INDIA Limited, Jharkhand 832108

Ref. Prj/Cert./02/ 2021

Date: 12.10.2021

TO WHOMESOEVER IT MAY CONCERN

This is to certify that Mr. Lakhindra Soren S/o Baset Soren student of B-Tech in Mechanical from Arka Jain University, Jamshedpur has successfully completed his industrial training from 11th September 2021 to 09th October 2021 in Production department.

We wish him for successful life.

For WABCO INDIA LIMITED

Kumar Raghaw
Site HR Leader

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INDUSTRIAL TRAINING REPORT

ON

"PRODUCTION IMPROVEMENT IN CONNECTING ROD"

Submitted in partial fulfilment of the requirement for degree of

B.TECH
in
MECHANICAL ENGINEERING
at
ARKA JAIN UNIVERSITY, Jharkhand

Submitted By
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AJU/181361

Under the Guidance of
VIVEK KUMAR
(ZF WABCO INDIA LTD)

SCHOOL OF ENGINEERING & I.T,
ARKA JAIN UNIVERSITY, JAMSHEDPUR
2018-2022

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ACKNOWLEDGEMENT

I would like to express my utmost gratitude to the AJU for providing an opportunity to pursue the engineering training as partial fulfillment of the requirement for the degree of B.Tech in Mechanical Engineering. The internship opportunity I had with ZF WABCO was a great chance for learning and professional development. Therefore, I consider myself as a very lucky individual as I was provided with an opportunity to be a part of it. I am also grateful for having a chance to meet so many wonderful people and professionals who led me through this internship period.

Bearing in mind previous I am using this opportunity to express my deepest gratitude and special thanks to the **Mr. VIVEK KUMAR ,KUMAR RAGHAV,ZF WABCO)** who in spite of being extraordinarily busy with his duties, took time out to hear, guide and keep me on the correct path and allowing me to carry out my project at their esteemed organization and extending during the training.

I express my deepest thanks to **Mr. VIVEK KUMAR ,ZF WABCO** for taking part in useful decision & giving necessary advice and guidance and arranged all facilities to make life easier. I choose this moment to acknowledge his contribution gratefully.

I express my deepest thanks to all staffs and employees of ZF WABCO for taking part in useful decision & giving necessary advice and guidance and arranged all facilities to make life easier. I choose this moment to acknowledge their contribution gratefully. I perceive as this opportunity as a big milestone in my career development. I will strive to use gained skills and knowledge in the best possible way, and I will continue to work on their improvement, in order to attain desired career objectives. Hope to continue cooperation with all of you in the future.

ABSTRACT

The aim of this training is to get exposed to the Production & Quality Engineering. Learning about Machining and Assembly, Production , Time Schedule, Job Design and Production Management.

I joined the company as trainee for one month training. In this report, I have highlighted the challenges that I encountered and the actions taken or solutions to problems during training in ZF Wabco, Jamshedpur(Jharkhand).

It was a rewarding opportunity for me to learn the work culture of Wabco as; how the organization work for the entire project, was structured, its hierarchy, how various departments work in coordination with one another inside the system to achieve a common target and predetermined goals, how the superior officers interact with the clients and contractors, how the information is being delivered from the top to the bottom level employees etc.

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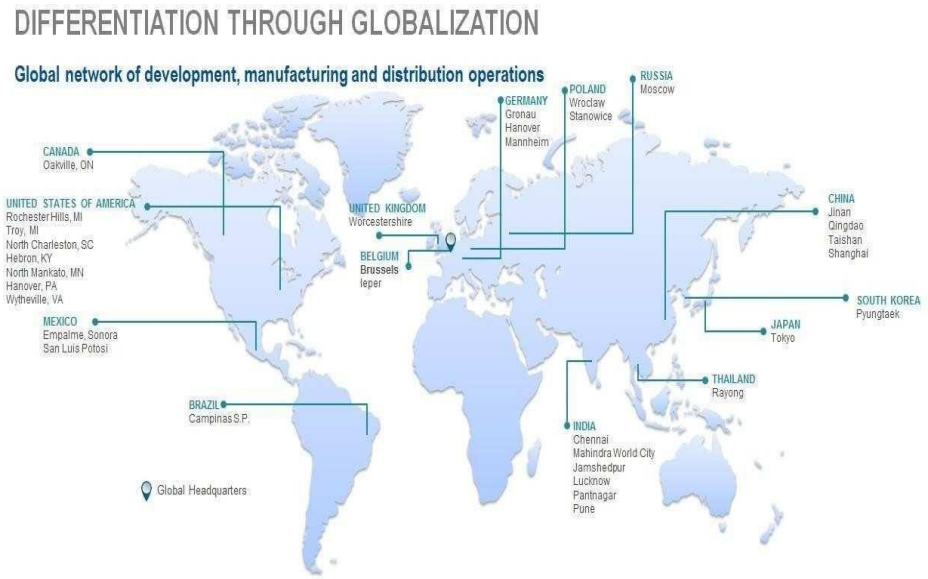
COMPANY PROFILE

ZF WABCO is a leading global supplier of technologies and services that improve the safety, efficiency and connectivity of commercial vehicles.

Founded nearly 150 years ago in, WABCO continues to pioneer breakthrough innovations for advanced driver assistance, braking, stability control, suspension, transmission automation and aerodynamics. Partnering with the transportation industry as it maps a route toward autonomous driving; WABCO also uniquely connects trucks, trailers, cargo, drivers, business partners and fleet operators through advanced fleet management systems and mobile solutions.

Headquartered in Bern, Switzerland, WABCO has 162,000 employees worldwide with approximately 260 locations in 41countries.

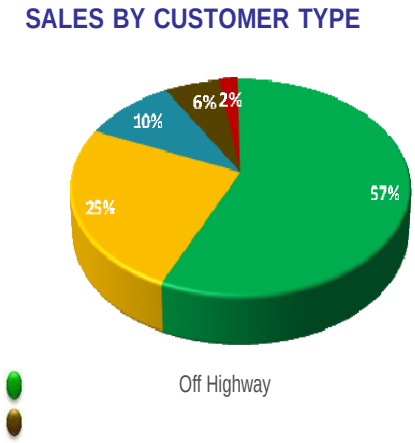
Earlier it went by the name WABCO but in 2020, it was acquired by ZF Friedrichshafen AG, a German multibillion dollar automobile parts making company which is also known as ZF Group having its headquarters in Friedrichshafen, Germany.



AREA OF BUSINESS

Whatever the vehicle, ZF WABCO help to make it safer and more efficient for both manufacturers and fleet customers. From advanced driver assistance systems and vehicle controls, to braking and suspension technologies as well as fleet management systems, WABCO offers state-of-the-art products that build on over a century of engineering excellence.

MARKET SEGMENT



WABCO INDIA

Operating under the ZF WABCO brand and part of ZF Group Commercial Vehicle Control Systems Division, WABCO INDIA Limited is India's market leader for advanced braking systems, conventional braking products and relatedair assisted technologies and systems in India.

Powered by its vision for accident-free driving and greener transportation solutions, WABCO India provides industry-leading solutions in the Autonomous, Connected and Electric (ACE) domains to commercial vehicleindustry in India.

Headquartered in Chennai, WABCO India has five manufacturing facilities, an advanced technology development centre, a vehicle testing facility and a nation- wide aftermarket distribution and services network.WABCO India designs, manufactures and markets conventional braking products, advanced braking systems, and other related air assisted products and systems. The company has grown significantly in the Indian commercial vehicle market and also serves its aftermarket customers through a wide national distribution network. With five world-class manufacturing facilities spread across India, Application Engineering Centre in Pune, technology center and a vehicle testing facility in

Chennai, WABCO India excels in engineering and manufacturing, serving customers locally and through WABCO globally. WABCO India Limited has over 4400 employees and reported Rs. 2103 crores in sales in FY 2016-17.

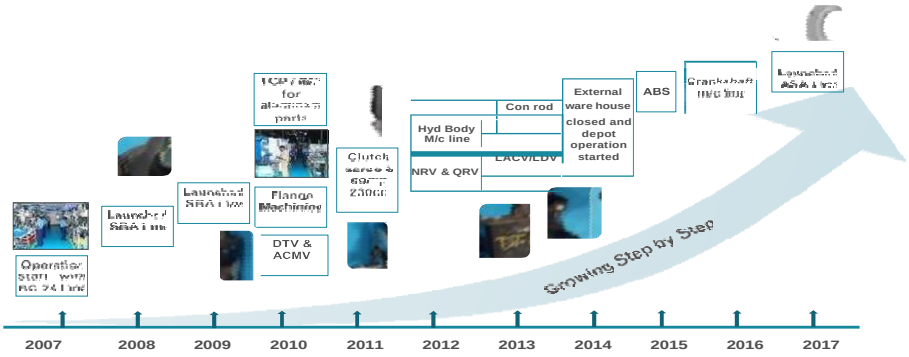
WABCO INDIA PLANTS:

WABCO INDIA PRODUCTS:

Complete range of air brake actuation systems – compressors, Air processing units, actuators, valves, brake chambers, slack adjusters, spring brakes, couplings hose assemblies, switches, vacuum boosters and advanced vehicle safety systems like Anti-lock brakes (ABS) and Roll Stability Control systems for light/medium and heavy commercial vehicles, Trailers and Car system.

WABCO INDIA JAMSHEDPUR(WINJ)

WABCO India Jamshedpur site situated in Steel city is catering to Tata Motors, Tata Cummins, Daimler & Jabalpur vehicle factory. Situated in a strategic location WINJ satisfies the need of major OEM situated in nearby location. The plant is equipped with 3 value streams, 35 Assembly cells, 10 machining cells, over 570 assembly parts & more than 110 suppliers. 76% percent of the total sale is supplied to Tata motors, 10.11% to Cummins & 12.97 percent of sales is executed via after market. Total no of employee strength is 513, Average age of employees is 26.1 years. WINJ has been capturing the steps of success with every passing year and been awarded with many from its customers for the consistent commitment to quality & excellence.\



WINJ SITE LAYOUT

CUSTOMER PORTFOLIO

WABCO Jamshedpur shares a strong customer base with an added advantage of its manufacturing facility being in close vicinity to its major customer i.e. Tata Motors. Other customer being Daimler, Cummins & Jabalpur Vehicle factory.


TATA MOTORS

DAIMLER

Cummins

Vehicle Factory Jabalpur

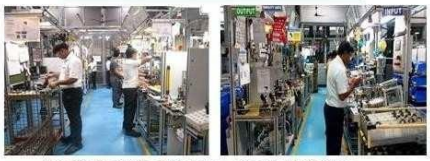
PROCESS AND MANUFACTURING FACILITY

WINJ is equipped with 3 value streams, 35 Assembly cells, 10 machining cells, over 570 assembly parts & more than 110 suppliers. Fig. 1.16 shows the manufacturing facility available.

- Three major value streams namely Machining, Assembly & IMP/TCP.

Machining

Assembly



IMP

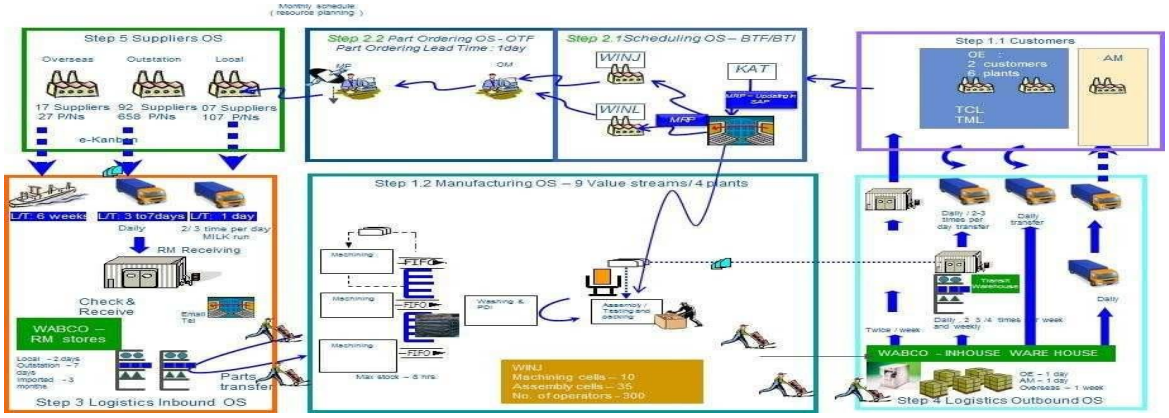
No of products added Vs capacity utilization

WINJ – MAJOR PRODUCTS

Major products of WINJ are listed below. Products are divided into differentproduct categories.

PRODUCTION SYSTEM AND GROUP CATEGORIZATION

All WINJ manufacturing units are designed in U-cell concept to minimize loss and improve efficiency throughout the system. Material flow is designed with minimum 3M waste and data flow is ensured via SAP to eliminate duplicity andimprove transparency.

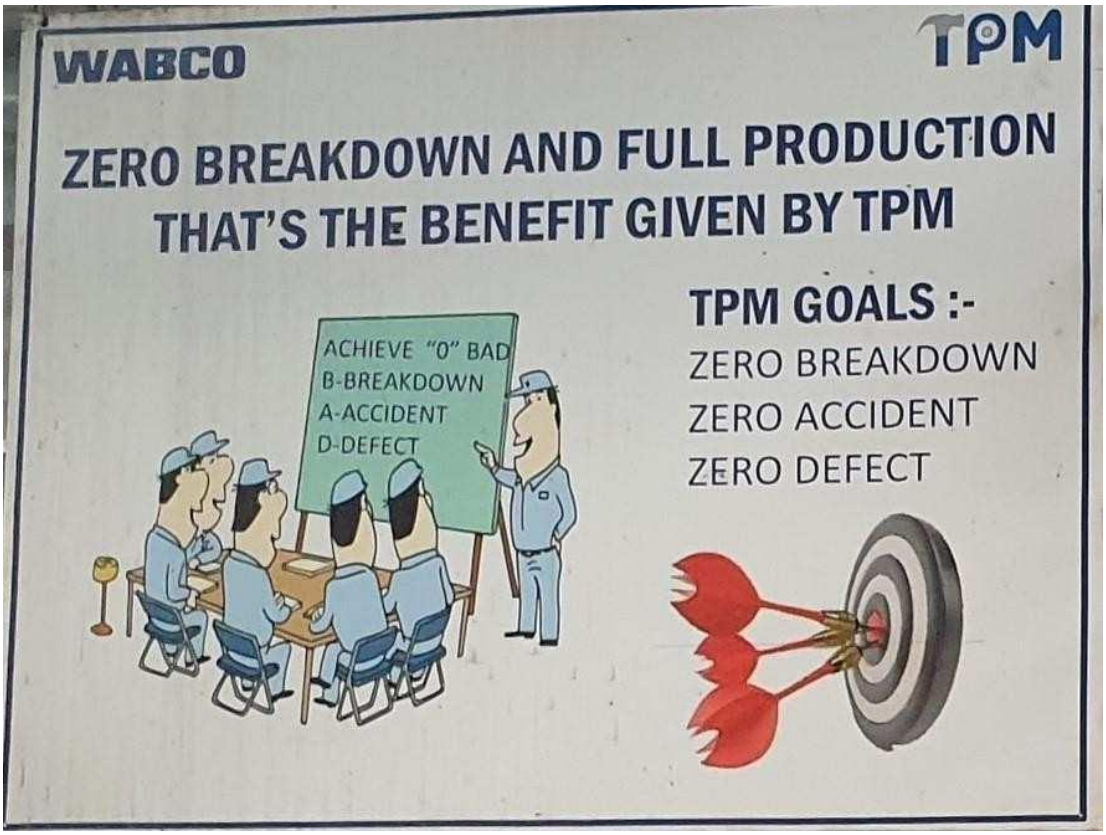


REASON OF SELECTION OF PROJECT

This project was undertaken with the aim of learning as much as possible aboutthe day to day working of the ZF WABCO Jamshedpur plant.

The project which was assigned to me was regarding the machining line balancing of the Connecting rod Line. The aim was to reduce the manpower by conducting time study and work measurement and eliminate unwanted waste and thus implementing the concept of TPM and promoting lean manufacturing.

Thus, owing to the high demand of the MV component, a need to maximize the man machine utilization and reducing the cycle time led to the assignment and selection of this project.



TARGETS:

The target of the project was to reduce the cycle time of the machining line and maximize the man machine utilization.

This was to be done on the Connecting rod machining Line wherein the existing number of stations were eight and the number of workers 2. The aim was to bring up the production by conducting time study and work measurement using a stopwatch and observing and eliminating the idle time ofthe man and machine and thus maximizing their productivity.

It was important to match the production rate to the takt time so that there is no delay in the lead time. Thus, the objective of the project involved machining linebalancing in order to improve the workflow from one station to another andincrease the overall efficiency of the entire cycle.

Thus, the primary goal was to incorporate the concept of lean manufacturing by implementing the principle of TPM(Total Productive Maintenance). To achieve this, it was necessary to identify unnecessary motion, idle time and bottlenecks to improve the throughput of the entire process.

Machining Line

Work content of 160cc Connecting Rod Assembly Line

1. **Station 1: Milling**

   Parts: Connecting Rod (Job)

   Steps:

- Firstly clean the bed.
- Clamp the job on the bed.
- Hammer the job to clamp properly.
- Close the door of the milling machine.
- Press the start button of the machine.
- Open the door after milling done.
- Remove the job and clean the bed.
- Pass the job to the next station.

2. **Station 2: BroachingParts: Job**

   Steps:

- Clean the bed .
- Clamp the job.
- Check it is clamped properly.
- Close the door.
- Press the start button of the machine.
- Open the door after Broaching done.
- Remove the job and clean the bed.
- Pass the job to the next station.

3. **Station 3:Drill ,Spot face , Tap and RoughDrill**
   Parts: Job

   Steps:

- **Clean the bed properly.**
- **Clamp the job.**
- **Close the door.**
- **Start the Machine.**
- **Open the door after drilling and tapping done.**
- **Remove the job and clean the bed.**
- **Pass the job to the next station.**

4. **Station 4: Mill to Split Con.RodParts: Job**

   Steps:

- Clean the bed properly.
- Clamp the job.
- Close the door.
- Start the Machine.
- Open the door after Split milling is done.
- Remove the job and clean the bed.
- Pass the job to the next station

5. **Station 5 : Deburr Table And Assembly OfCon.rod.**
   Parts: Split JobSteps:

- Surface finishing of both split part in sand paper .
- Assembly of both split part with screw.
- Chamfering both the holes.
- Cleaning .
- Check the job if OK pass it to next station.

6. **Station 6: Washing**
7. **Station 7: Fine Bore Parts: Assembled job**

Steps:

- Clean the bed.
- Clean the fixture.
- Clamp the job.
- Close the door.
- Start the machine.
- Open the door after machine is stopped.
- Remove the job and clean the bed.
- Pass the job to the next station

Station 8: Deburr TablePart: Job

Steps:

- Clean the job.
- Removal of sharp edges.
- Checking the Holes dimension with bore dial gauge.
- If OK then keep it to the storage box.

SUGGESTIONS AND EXPECTED RESULT

For Con.rod Line 1, suggestions were based with the aim of production improvement and reduce cycle time.

In the present setup, total number of operator is 2 but by means of varying cycle time 2 operator can operate the Con .rod line.

However due to the varying cycle times of the different stations, there was irregular flow of materials along the stations

Based on this, it is suggested that one operator (1) be assigned to station 1, station 2 and station 3 and station 7 which would make the combined total time for these three stations 2 min to make a single part in each station plus 2 part in station1 and 2.

It is suggested operator(2) be assigned to station 4 and station 5 and station 6 which would make the combine total time for these two station 2 min

It is suggested while operation 3rd is in process at that time operation 1can complete 2 job .

It is suggested while operation 3rd is in process at that time operation 2 can complete 2 job.

It is suggested that second operator be assigned to station 4 , 5 and 6 which would take combine total time of 2minute to make a singlepart in each station plus 2 part in station 4 .

It is suggested not to over lap each other station and not changing the station pattern and walking pattern.

It is suggested for station 1 to provide a bin to store the job since the operation

2 is faster than operation 1so in advance more amount of job should be pre ready so the movement of the operator2 dosnot stop, if bin will be provided here then the jobs can be pre ready for operation 2 which will help for continuous movement of operator and it will also help in increasing the output. **It is suggested for every station** to calculate the operation time and there walking time so that they can be at the right place at the right time for continuous production which will be reduce ideal time and it will help in increasing the output, as the operator will get more time for making the components in the stations.

It is suggested to provide a proper bin for collecting the coolant because operator has check whether the coolant is fill or not .If the coolant is filled they have to change the bin other wise the coolant will leak to the ground .So this divert the operator for doing continuous operation on the station.

It is suggested that a maintenance team should look to the stations because there are problems in the working of the machine which lead to operator to stand and watch the operation is going on properly or not .Sometime operator has to re mount the cutting tool since it does not reclamp by itself but is has to reclamp by its own which lead to operator to stop the machine and operate it manually and mount the tool manually which waste a lot of time of the operatorand lead to others operation to be ideal position.

OTHER LEARNINGSMACHINING

1. **Worldtruck Flange:**

The worldtruck flange is used in the assembly of Spring Brake Actuator which is finally used in the airbrakes of trucks.

Machining operations are done in a CNC Turning machine and Vertical Milling machine on the casting which arrives from third party companies such as Aldica Engineering.

Some of the operations performed on the flange in CNC Turning are Facing,boring and grooving.

The cycle time for above operations is 1 min 15 secs.

Next, machining is done on a VMC in which Spot facing, drilling and tapping operations are done. The cycle time for this 50 secs and the output per hour is 80.

Some of the before and after machining pics of the flange are as follows:

Before:

After:

Some of the gauges used to perform quality inspection are:

- Screw Gauge
- Plug Gauge (M22 X 1.5)
- Wing Gauge (To check the bore and groove distance)
- Groove dial gauge (To check the bore diameter)
- Dial indicator(To check the depth)
- Width gauge
- Gap gauge

2. Cylinder Head 230 cc:

The machining of cylinder head is done in a Vertical Milling Machine. The casting is made of Aluminium and is outsourced from an industry named Mesha Engineering. Aluminium cylinder heads are used instead of cast iron as the aluminium cylinder heads are much lighter and give much better performance.

The operations performed on cylinder head are milling, Spot facing and tapping (M26 X 1.5). The cycle time for these operations is 1 min 40 secs. After these operations are performed in the VMC, the deburring operation is performed in a deburring station next to it followed by washing in a third station.

Some of the before and after machining pics of cylinder head are as follows:

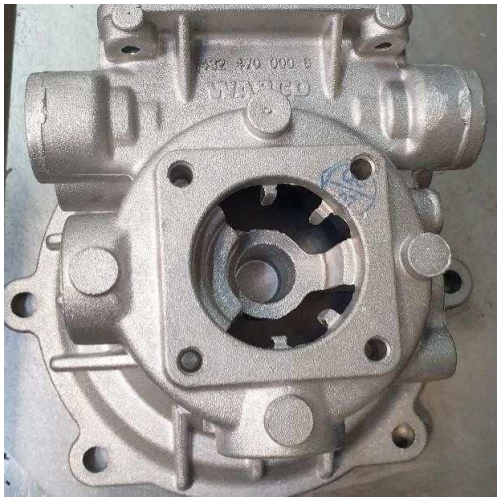
Some of the instruments used for inspection are plug gauge, thread gauge, vernier callipers, bore dial gauge, height gauge etc.

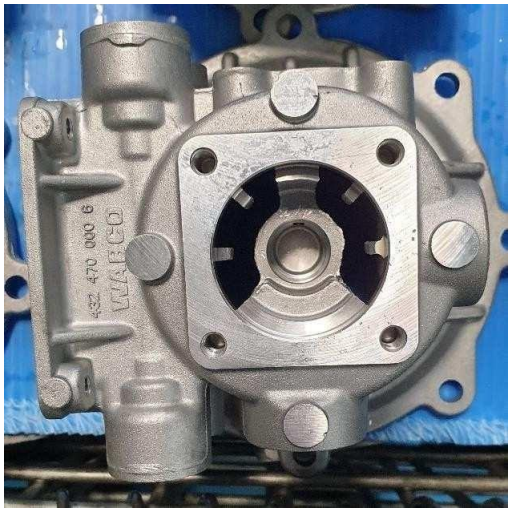
3. DDU Machining:

DDU stands for Drying and Distribution Unit. It is used in the circuit of an air brake system of an automobile.

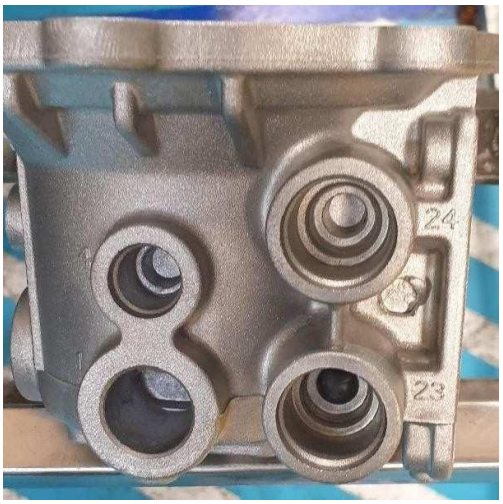
The machining operations are as follows:

- First the facing, drilling and tapping operations are done on the NRV, QSPV and base side on the VMC 400 machine. QSPV stands for Quadruple System Protection Valve whereas NRV stands for Non Return Valve.





- Next, the facing and drilling operations are done on the Governor side and Port Side of the DDU unit on the VMC 300 machine.



- Then the straight drill and cross drill operations are performed followed by the washing. It is then sent to the TCP Plant for rinsing and then finally to the Assembly Line for assembly in the DDU unit.

CONCLUSION:

This project has proved to be a great learning curve for me. In the process of observing and analysing the different activities of the Connecting Rod line, I became acquainted with the concepts of TPM (Total Productive Maintenance), Kaizen, Jishu Hozen, 5S etc. Over the course of my industrial training, I understood these concepts in depth and the practical applications of these Japanese concepts were evident in the work environment of the various assembly lines as well as the entire company itself.

Small continuous improvements such as making a tool holder and mounting it on the machine itself so that the worker should not waste time in finding the tools helped me understand the concept of Kaizen.

The concept of 5S (Sort, Set in Order, Sanitize, Standardize, Sustain) was efficiently implemented in the workshop which made the entire line very organized and spick and span with every component being placed in allocated position. The material handling trolleys also moved only within the gangways toavoid any delay or accident.

The concept of Jishu Hozen was also efficiently implemented in which the operators would maintain their machines themselves which was also mentioned in the operational plan as pre shift and post shift activities such as cleaning, checking various parameters before starting the shift such as oil level, proper working of tools etcetera to avoid mistakes during the process, that is, mistake proofing (Poka Yoke Concept).

What did this is rather than burdening and relying solely on the maintenance team to maintain the equipment and machines, it gave a sense of belonging and responsibility to the operator which helped him become better at maintaining

and doing his job by giving appropriate suggestions as he knows the machine inside out. This further helped implement the concept of Kaizen within the company.

By conducting time study and work measurement, I could better understand the concept of man machine utilization and how to balance any assembly line based on that. It helped me understand the intricate details of each and every station as I scrutinized each and every action of the operator working on the machine. The concept of takt time was also novel to me and I understood how it is dependent on the customer demand and in what ways it is related to the lead time.

Owing to this, I could give suggestions to reduce the personnel and make the assembly line better balanced, thus improving the workflow and overall efficiency.

The entire experience helped me understand the meaning of "Lean Manufacturing" concept wherein we eliminate wastage by avoiding unnecessary actions, reducing waiting time, inventory, motion and eliminating defects.

Thus, the entire project helped me become a better learner by observing each and every operation in detail and employing the Socratic way of thinking by asking questions regarding each step. I also understood how to solve any problem in a system manner and finding the root cause of any trouble .

Thus I would like to conclude by saying that this project has helped me amass great knowledge in the Lean Manufacturing and Assembly Line field and me a better person by compelling me to think better and apply the concepts practically to optimize any process and make the company more profitable by improving the throughput.