

ACS COLLEGE OF ENGINEERING

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DEPARTMENT OF MECHANICAL ENGINEERING

ONE-DAY INDUSTRIAL VISIT

On

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Construction Equipment

Peenya, Bangalore



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We am very grateful to Mr. Balasubramanya K for providing me with this opportunity to work in Volvo Construction Equipment Road Machinery Line in Production Department.

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INTRODUCTION OF THE COMPANY

VOLVO CONSTRUCTION EQUIPMENT

Volvo Construction Equipment – Volvo CE – (originally Munktells, Bolinder-Munktell, Volvo BM) is a major international Company that develops, manufactures and markets equipment for construction and related industries for construction and related industries. It is a subsidiary and business area of the Volvo Group.

Volvo Construction Equipment (VCE) was started in 1832 in Eskilstuna, which makes it the oldest industrial company in the world still active in construction machinery. VCE has grown and developed throughout the years through a number of mergers and acquisitions. The company manufactures construction machines such as articulated haulers, excavators and wheel loaders. VCE is a part of the Volvo Group which has approximately 100,000 employees, production in 25 countries and operates on more than 185 markets. VCE has approximately 15,000 employees worldwide VCE has a wide market share of 7% of the construction equipment industries market worldwide. Wheel loaders are the second largest business area after excavators within VCE, representing 24% of VCE's total sales.

VOLVO PRODUCTION SYSTEM (VPS)



Volvo Production System (VPS) was introduced in 2007 as a way to continuously improve quality, delivery and productivity. VPS is the Volvo way in actions – how Volvo goes from Words to action. It contains practical tools that when used correctly, helps the organization to work towards its shared goal. VPS has 5 core principles which are thought to assist and guide the organization towards its goal:-

- Teamwork creates an efficient organization where all employees are involved and committed to the continuous improvement work. This way, all employee contribution to the overall goal of the organization, everyone's experience, knowledge and creativity is captured.
- By establishing deep knowledge and understanding a stable process can be created. This means reduced variation and waste which makes the process predictable and efficient.
- Doing things right the first time is referred to as built-in quality. Conforming to a built in quality philosophy means fixing problems as they occur which in turn helps the organization to move towards a zero-defect production.
- Just in time means producing and delivering what is needed, when it is needed in the quality needed. In other words, a pull strategy helps the organization to produce only what the customer wants in the shortest lead time possible.
- Apply Continuous improvements will require a long term approach but at the same time the driving force in the organization.

INTRODUCTION TO MANUFACTURING FACILITY

Volvo Construction Equipment – Volvo India Private Limited, Bangalore is a subsidiary of Volvo AB. The Bangalore Plant manufactures – Soil Compactors, Excavators, Pavers and rollers.

This manufacturing facility is located in the heart of Bangalore's - Peenya Industrial Area where the company has two assembly lines

- Road machinery assembly line
- Excavator assembly line

This manufacturing facility is consisting of six departments'

- 1. Assembly Shop
- 2. Fabrication Shop
- 3. Parts Paint Shop
- 4. Test Drive Inspection
- 5. Touch Up Paint Shop
- 6. Pre Delivery Inspection



Models Assembled in Plant

Road Machinery:

1. SD110 Compactor



Engine: Cummins B3, 9 – C Engine Power, KW / HP: 99 / 133 Static axle, Load front / rear (Kg) : 6000 / 4325 Drum width (mm): 2134 Drum Diameter (mm): 1500 Vibration frequency (Hz): 0 – 30 Centrifugal force (kN): 2224 / 1112 Amplitude (mm) : 170 / 085

2. DD100 Compactor



It is the ideal roller for asphalt contractor operations of varying sizes, working in versatile application

Eight amplitude settings

Automatic eccentric rotation

Impact spacing meter

3. PT220 Compactor



It is the 22 – 24 tonne pneumatic tire road roller

Road roller features eight air – filled rubber tires, & is ideal for paving contractors working in highway applications.

This efficiently follows double drum compaction machine, to provide smooth, even asphalt mats with less passes.

Maintenance – free hydrostatic drive and steering system.

4. Paver



EXCAVATOR:

- 5. EC210B
- 6. EC290B
- 7. EC210B NLC



ASSEMBLY SHOP

ROAD MACHINERY ASSEMBLY LINE

Road Machinery assembly line, which consists of SEVEN main stations on the main assembly line and NINE feeder stations that sub assembles various parts and send it to the main station line that will be mounted on main frame of the road machinery.

The standardized process carried out at each work station and feeder is discussed at the later stages of report.

The feeder time and station assemble time are all synchronized in such a way that the sub assembled parts from feeder, station arrives to the main station line at the right time when needed to mount on the main frame of road machinery.

The road machinery assembly line is monitored by ANDON system.

There are several improvements (KAIZEN) implemented in the assembly line of road machinery.

Similarly, there are several improvements on POKA - YOKE and KAIZEN

The layout of road machinery assembly line is as follows



The 9 feeder stations of the road machinery assembly line are (in particular SD110):

1) Feeder Station 1 (F1) – Axle Sub Assembly Area

The frame is bought into the feeder. The required valves are prepared and placed in the frame. The hose pipes are placed at appropriate positions. The electrical harness (main harness) is placed and fixed, sent to station 1.

2) Feeder Station 2 (F2) – Tank Sub Assembly Area

The fuel tank's i.e. the diesel tank and hydraulic tank are pre-assembled. Swivel frame is took and the bolt is fixed into it, sent to the station 2 for fixture.

3) Feeder Station 3 (F3) – Engine Sub Assembly Area

The engine imported from Germany is bought into the feeder and the capacity of the engine is 4 - cylinder, 133 HP, 99 KW, 2200 RPM. The vibration pump and the steering pump is connected to the shaft. The required hose pipes are joined. The engine oil is filled (15 liters).

4) Feeder Station 4 (F4) – Console Sub Assembly Area

The seat console frame is taken into the feeder and the steering pump and the fuses is connected to the frame. The seat assembly is attached to the frame. The required hose pipes are connected.

5) Feeder Station 5 (F5) – Hood Sub Assembly Area

The filters are fixed onto hood. Then the hood is attached to its second part of it.

6) Feeder Station 6 (F6) – Drum Frame & Exhaust Sub Assembly Area

The railings are fixed to the main frame. The center console control system is fixed (switches). The roof is pre-assembled and fixed in the station 6.

7) Feeder Station 7 (F7) – Rops, Scrapper, Tyres

The rops mounting is used to fix the roofs. The scrappers of the drum (drum cleaner). The pre-assembled tyres are bought into the feeder and sent to station 7.

8) Feeder Station 8 (F8) – Drum Cell

The fabricated and painted (inner) drum is placed in this feeder and the carrier and spindle alignment, the vibration pump is fixed and the leak test is done before filling the drum oil.

9) Feeder Station 9 (F9) – Drum Sub Line

The components are first washed and the sleeve is inserted into the speed sleeve. The pin is fixed into it using a journal pressure pin fixture. The speed sleeve is then attached to the spindle and this assembly is fixed using a nut and a bolt. The carrier and spindle assembly is done by using templates and cold as well as hot bearings.

The 7 Main stations of the road machinery assembly line are:

1) Main Station 1 (S1) – Main Frame and axle Installation

The rear axle is bought and placed on the main assembly line and the main frame is placed onto it and it is fixed. The required hose and harness are fixed and sent to next station.

2) Main Station 2 (S2) – Tanks and Swivel Frame Installation

The sub-assemblies of the swivel frame and the tanks are bought into the assembly line and assembled. The swivel frame is fixed using a hydraulic torque wrench. The appropriate hose pipes and harness are connected and sent to next station

3) Main Station 3 (S3) – Engine Installation

The engine assembly is bought into the assembly line and it is aligned to the desired position in the frame and it is assembled. The required hose and harness are connected and sent to station 4.

4) Main Station 4 (S4) – Battery and Silencer Installation

The pre-assembled battery is placed and connected to the engine. The silencer is connected to the exhaust of the engine. The seating console is bought into the assembly line and assembled into the frame.

5) Main Station 5 (S5) - Cowling, Hood, Hydraulic Piping Installation

The hydraulic piping is installed into with the swivel frame and it is attached to the hydraulic tank. The engine hood is fixed to the engine. The hood locking is aligned using a template and drilled and fixed to the hood.

6) Main Station 6 (S6) – Drum Frame, Rops And Railing Installation

The fabricated drum frame is moved to the assembly line, aligned and then fixed with a plate to hold it with the swivel frame. The fabricated rops are also moved, aligned and fixed to the main frame at its appropriate position in the frame. The railings near the seating console are aligned and fixed to the frame.

7) Main Station 7 (S7) –Scrapper, Tyre, Electrical Battery Routing Installation

The assembled drum is moved to the assembly line, aligned to the drum frame and fixed to the drum frame using a hydraulic torque wrench. The tyres are bought into the assembly line and fixed to the rear axle of the machine. All the left over hosing and harness connection is done. Including the head light, tail light, and the number plate (front and back). Then it is sent for test driving.

EXCAVATOR ASSEMBLY LINE

Excavator assembly line consists of NINE main stations on the main assembly line and FIFTEEN feeder stations sub assemble various parts and sends it to the main station line that will be mounted on main frame of the excavator.

The standardized process carried out at each work station and feeder is discussed in the later stages of report.

The feeder time and station assemble time are all synchronized in such a way that the sub assembled parts from feeder station arrive to the main station line at the right time when needed to mount on the main frame of excavator.

The excavator assembly line is monitored by ANDON system.

There are several improvements (KAIZEN) implemented in the assembly line of excavator.

Similarly, there are several improvements on POKA – YOKE and KAIZEN



The layout of excavator assembly line is as follows:

The 11 Feeder stations of the excavator assembly line are:

1. Feeder Station 1 (F1) - Block Sub Assembly

The main upper frame arrives to the station line. The cleaning process is carried out for the upper frame. After cleaning is done fixing of grease plate and headlight is on the frame. Later stages the light cover, coolant pipes are fixed on to frame

1) Feeder Station 2 (F2) - Bottom Plate Sub Assembly

At this station bottom plate is lifting to the sub assembly fixture. Joystick pedals and foot rest brackets are laid on the frame. Electric harness flanges are fixed at next working stage of this station. AC vent hoses are fixed and placed at the bottom plate. Routing of hoses trough guide rubber is done. The seat assembly is lower to the bottom plate. AC vents are connected; the RCV hoses are attached to the block. After all the operations are completed the bottom plate sub assembly is lifted and mounted on main frame.

2) Feeder Station 3 (F3) - Boom Cylinder And Radiator Sub Assembly

At this station AC condenser is fixed. The boom cylinder is placed on the fixture. The hydraulic solid pipe, greasing adapters are assembled on to the boom cylinder. The next operation is to mount the radiator on the frame and the radiator guard is attached. Hoses are connected to the radiator. The sub assembly is mounted on the main frame.

3) Feeder Station 4 (F4) - COWL Frame Sub Assembly

The COWL sub assembly consists of cowl doors and cowl frame. They are assembled on the cowl frame table. The sub assembled parts are lifted and mounted on the engine and radiator.

4) Feeder Station 5 (F5) - Swing Motor Sub Assembly

At this feeder, the swing motor is placed on the fixture. Adapters and nipples are attached to the swing motor while on the fixture. Hydraulic oil is pumped to the swing motor and is ready to be assembled to the main frame.

5) Feeder Station 6 (F6) - Cabin Sub Assembly

The readymade cabin arrives to the feeder station. Here the various parts that have to be mounted inside the cabin are placed and fixed. Electric cable, dashboard and foot pedal are placed and fixed inside the cabin.

6) Feeder Station 7 (F7) - Boom and Arm Docking

The boom and arm arriving from feeder station 15 with bushes are put together and docking pins are inserted.

7) Feeder Station 8 (F8) - Main Control Valve Sub Assembly

MCV is placed on the oil drain fixture. Sub assembled tank is positioned. The O ring is inserted and the hydraulic pipe is installed. The next operation is to connect hydraulic hoses on front side and back, RH top side and LH side.

8) Feeder Station 9 (F9) - Engine Sub Assembly

At this feeder station, Engine block is lifted and placed on the fixture. The next operation is to remove the clamps. Certain brackets are placed and tightened. The muffler pipe is connected along with electrical harness. The oil hose clamps are fixed. The AC Compressor is mounted and belt drive for compressor is fixed and radiator outlet is connected. The next operation is to fix various adaptors, water supply hose and connecting electrical harness to different compartments. Lastly the engine oil is filled, to prevent accidents/ mistakes POKA – YOKE is implemented to stop the engine cart from moving unless oil is filled with the help of stopper.

9) **Feeder Station 10,11,12,13 (F10, F11, F12, F13)** - Lower Frame Sub Assembly Lower frame sub assembly is divided into four subassembly departments:-

- Lower frame sub assembly 1 (F10)
- Lower frame sub assembly 2 (F11)
- Lower frame sub assembly 3 (F12)
- Lower frame sub assembly 4 (F13)

The following process takes place in all the four lower frame subassembly work:-

The lower frame with swing gear is installed on resting fixture and inverted. The sprocket track motor assembly is assembled on to the lower frame. The idler wheels are sub assembled and is installed on to the frame. Recoil springs are installed to the frame absorbed shocks.

The track motor chain belt is placed on the wooden fixtures and the assembled frame is lifted and placed on the chain. After the chain belt is fixed to the frame the swing gear is lubricated with 17kg for model EC210 and 34kgs for EC290 excavator.

10) Feeder Station 14 (F14) - Tank Sub Assembly

11) Feeder Station 15 (F15) - Boom and Arm Sub Assembly

The bushes are inserted to boom and arms of the excavators. The bushes are placed in a tank and liquid nitrogen is poured and closed for few minutes until it cools and contracts. After few minutes, the bushes dipped in nitrogen are picked up and inserted into the arm and boom of the excavator pressure to fit bush into the hole. After the bush is inserted, the boom cylinder is installed and various hose pipe for hydraulic oil are mounted and locked. The assembled boom and arm sent to the main station.

The 9 Main stations of the excavator assembly line are:

1) Main Station 1 (S1) –MCV and Tank Insertion

The sub assembled parts from MCV feeder arrive on to the main station along with block sub assembled from the opposite feeder station. At this station, MCV unit is mounted on to the main frame of excavator and bolted.

2) Main Station 2 (S2) –Bottom Plate Insertion

At this station, bottom plate sub assembly from feeder station 2 arrives along with engine sub assembly from feeder station 9. It is mounted on main frame and fixed.

3) Main Station 3 (S3) –Boom Cylinder Placement

Seat and battery box are mounted and fixed to main frame of excavator along with the routing of various hoses.

4) Main Station 4 (S4) – COWL Frame Insertion

Radiator and hydraulic cylinders are installed and fixed on to upper frame of excavator.

5) Main Station 5 (S5) –Swing Motor Insertion

Engine and radiator cowl frame and cowl door is installed on the main frame in which radiator and engine is already mounted.

6) Main Station 6 (S6) – Lower & Upper frame Alignment

The assembled main upper frame with all the parts on is ready to be mounted on the lower frame which arrives from feeder 13. With help of a crane upper frame is mounted on the lower frame and bolts are inserted and tightened.

7) Main Station 7 (S7) – Fuel Filling

The lower frame and upper frame assembled in the excavator now arrives to this station. At this stage the fuel, coolant and hydraulic oil is pumped. POKA – YOKE is used while pumping to avoid any mistakes.

8) Main Station 8 (S8) – Counter Weight Insertion

After the oil, coolant and fuel is filled, the excavator is switched on for the first time and moved to this station. Here cabin sub assembled at earlier stages arrives and is mounted on the excavator. A counter weight is added to balance the weight of excavator at back.

9) Main Station 9 (S9) – Arm and Bucket Placement

Boom and arm are installed at this station to the excavator which arrives from feeder 15 with bushes already inserted along with hydraulic cylinders and moved outside assembly line to texting area.

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Photographic View at Volvo Construction Equipments Peenya, Bengaluru



Photographic View at ACSCE