

# **SUMMER**

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# **TRAINING REPORT**

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## **JCB INDIA**

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# **ACKNOWLEDGEMENT**

*Its a great pleasure to present this report of summer training in JCB at Ballabgarh in partial fulfillment of B.Tech Programme under Guru Jambheshwar University of Science & Technology,Hissar.*

*At the outset, I would like to express my immense gratitude to my training guide Mr. Mahender Singh Negi who guided me right from the inception till the successful completion of the training.*

*I am falling short of words for expressing my feelings of gratitude towards him for extending his valuable guidance about all the aspects of manufacturing from technical level to administrative level and support for literature, critical reviews of project and the report and above all the moral support he had provided me throughout all stages of this training.*

*I would also like to thank my friends and all my group members for their help and cooperation throughout the training.*

**Trainer**

**Mr. Mahender Singh Negi**

**JCB INDIA LTD.**

# **INTRODUCTION**

*The company is JCB (Joseph Cyril Bamford Excavators Limited).It's founder is Joseph Cyril Bamford (1916-2001).*

*Who always followed the motto :*

*"You know my motto from my initials J.C.-Jamals Content-that's very very much me.I am never content."*

## **JCB Heritage :**

*What begin in a garage of 12 feet by 15 feet back in 1945,today manufacturers over 220 models of construction & agricultural equipments on four different continents with bases in U.K.,the U.S.,India & South Amrica.*

*JCB world headquarters is one of the finest engineering factories in Europe and sells a full range of equipments in over 150 countries.*

*Today,JCB is one of the world's largest construction equipment manufacturer.*

*It follows policy of  $E=MC^2$*

*Where E = Energy to infuse "sense of urgency"*

*M = Motivation to win*

*C = Challenge*

*C = Care & Commitment*

# **Joseph Cyril Bamford**

**---Founder 1916-2001---**

*I was once asked as a founder of JCB ,what it took to succeed.'The same thing it took to get started.'*

*I said, "a sense of urgency about getting things done ."*

*The people who makes things move in this world share this same sense of urgency.*

*No matter how intelligent or able you are,if you don't have the same sense of urgency,now is the time to start developing it.The world is full of very competent people,who honestly intend to do things tomorrow,or as soon as they can get around it.Their accomplishments however seldom match those of less talented who are blessed with a sense of importance of getting started now.*

*(Joseph Cyril Bamford)*

*Founder 1916-2001*

# **PRODUCTS MADE IN THE PLANT**

## **1. JCB 3DX BACKHOE LOADER :**

*It is the machine which comes under the category of earth movers in which there is a bucket fitted in the front portion of the machine & an excavator fitted backwards which are used to dig earth or transfer it from one position to other. This machine does 3-dimensional movement during its working that's why, it is called 3DX Backhoe Loader. Its functioning is totally based on hydraulics.*

*Features :*

*Engine*

- 76 horsepower fuel efficient KOEL engine with increased size of coolers for better performance in hot and dusty working conditions.*
- New transmission designed to provide high traction forces and long life for continuous loading duties.*
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- Low Fuel Consumption.*

*Performance*

- Increased shovel capacity of 1.1 cu.m. with high breakout forces give extraordinary loader productivity.*
- Improved performance. Increased diesel tank capacity, protection on excavator, hoses and improved excavator valve block feature, ensure even better excavation economics.*
- Highest Productivity in Class.*

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### *Design*

- *D section loader arm and chassis design gives lifelong structural durability.*
- *Pannier design diesel and hydraulic tanks greatly add to the operator .*
- *High Versatility.*
- *Strong Excavator End.*
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**3DX Backhoe Loader**



## **2. JCB 3DX Super :**

*Its construction, functioning, working as well as area of applicability is very Much similar to that of the 3DX Backhoe apart from the only difference That, it is a 4-wheel drive machine giving it more power & edge over the 3DX Backhoe Loader.*



**3DX Super**

## **3. 4DX Backhoe Loader :**

*This machine is also quite similar to 3DX Backhoe Loader apart from the difference that it's forward bucket area as well as volume can be increased or decreased according to the need of the user thus making it a 4-dimensional working machine as it called so as 4DX Backhoe Loader.*

*Features :*

- *Strong excavator ends*
- *4 wheel Drive machine*
- *Two Dig depth option*

- *Bigger coolers to work in hot and dusty conditions.*
- *96hp powerful engine*



### **4DX Backhoe loader**

## **4. Liftall :**

*LIFTALL – Lift and Carry Mobile Crane.*

*The first model, JCB Liftall – 1253 is a 12T capacity mobile crane fitted with a telescopically extendable 3-part boom and is very useful for the erection and construction sites, container, steel and timber yards. This will be a highly useful tool for equipment rental companies because of its versatility.*

*This is the only machine in its class presently in India with European standard (IP-69) electrics, making the piece of equipment very reliable. It also has many exclusive and superior features, best in class, like height of lift 12.5m under hook; travel speed – 30 kmph; a very sturdy transmission for more reliability; unrestricted visibility on full height and wider wheel track, altogether making it a safe and highly useful machine for erection and container jobs.*

*Like all JCB products, the Liftall offers unparalleled operator comfort, with its insulated ceiling, fan, long helper seat (adequate for overnight sleep on distant sites) and large tool box. All controls are ergonomically designed for better operation.*



## Liftall

*These are the four products which are manufactured at the JCB (Balabgarh) plant which is world's largest plant for the manufacturing of backhoe loaders.*

*Here, at JCB 75 Backhoe Loaders are produced daily with it's 5 working days in a week out of which generally four days are of production & 1 day in a week is NPD (Non-Production day). On NPD, there is no production but the reworking of the produced goods are done as well as plant's inspection takes place.*

# HOW JCB MACHINE WORKS

## The Basic Idea of hydraulics :

*The basic idea behind any hydraulic system is very simple: **Force that is applied at one point is transmitted to another point using an incompressible fluid.** The fluid is almost always an oil of some sort. The force is almost always multiplied in the process.*

*If two pistons fit into two glass cylinders filled with oil and connected to one another with an oil-filled pipe. If you apply a downward force to one piston (suppose the left one), then the force is transmitted to the second piston through the oil in the pipe. Since oil is incompressible, the efficiency is very good -- almost all of the applied force appears at the second piston. The great thing about hydraulic systems is that the pipe connecting the two cylinders can be any length and shape, allowing it to snake through all sorts of things separating the two pistons. The pipe can also fork, so that one **master cylinder** can drive more than one **slave** cylinder if desired.*

*The neat thing about hydraulic systems is that it is very easy to add force multiplication (or division) to the system. In a hydraulic system, all you do is change the size of one piston and cylinder relative to the other, as shown here:*

**Hydraulic multiplication** :*Suppose the piston on the right has a surface area nine times greater than the piston on the left. When force is applied to the left piston, it will move nine units for every one unit that the right piston moves, and the force is multiplied by nine on the right-hand piston.*

*To determine the **multiplication factor**, start by looking at the size of the pistons. Assume that the piston on the left is 2 inches in diameter (1-inch radius), while the piston on the right is 6 inches in diameter (3-inch radius). The area of the two pistons is  $\text{Pi} * r^2$ . The area of the left piston is therefore 3.14, while the area of the piston on the right is 28.26. The piston on the right is 9 times larger than the piston on the left. What that means is that any force applied to the left-hand piston will appear 9 times greater on the right-hand piston. So if you apply a 100-pound downward force to the left piston, a 900-pound upward force will appear on the*

*right. The only catch is that you will have to depress the left piston 9 inches to raise the right piston 1 inch.*

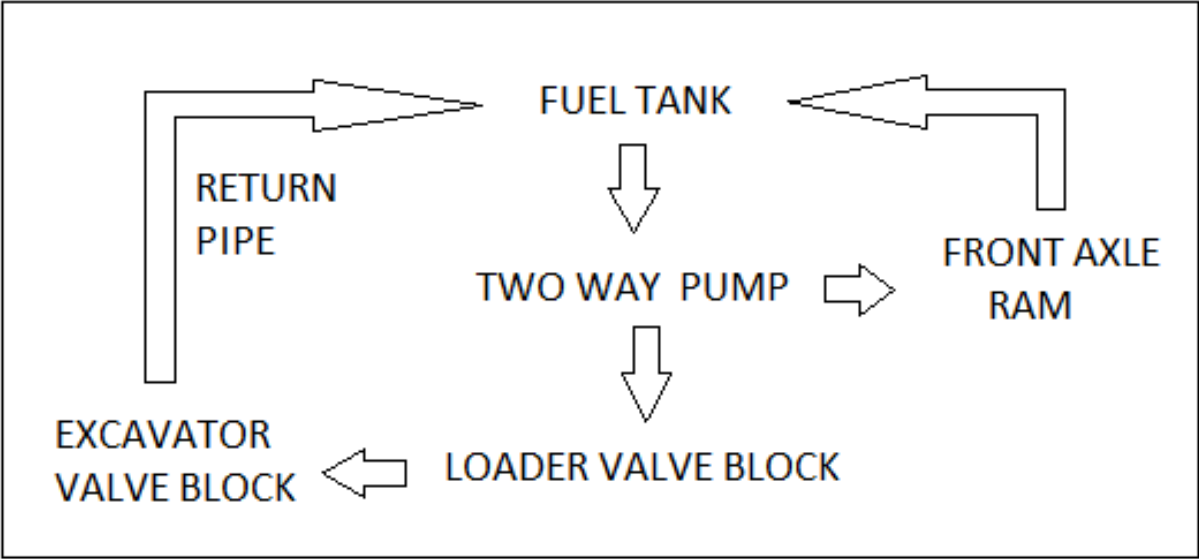
### *Air in the System*

*It is important that a hydraulic system contains no air bubbles. We may have heard about the need to "bleed the air out of the brake lines" of our car. If there is an air bubble in the system, then the force applied to the first piston gets used compressing the air in the bubble rather than moving the second piston, which has a big effect on the efficiency of the system.*

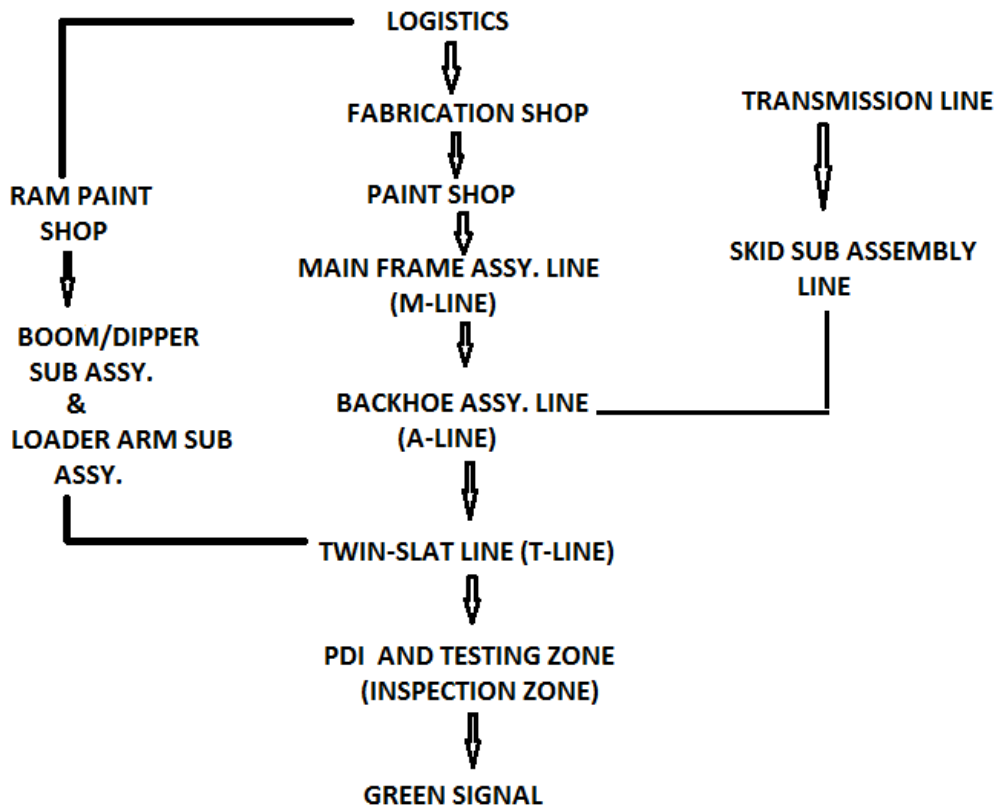
*The brakes in our car are a good example of a basic piston-driven hydraulic system. When we depress the brake pedal in our car, it is pushing on the piston in the brake's master cylinder. Four slave pistons, one at each wheel, actuate to press the brake pads against the brake rotor to stop the car. (Actually, in almost all cars on the road today two master cylinders are driving two slave cylinders each. That way if one of the master cylinders has a problem or springs a leak, we can still stop the car.)*

*In most other hydraulic systems, hydraulic cylinders and pistons are connected through valves to a pump supplying high-pressure oil.*

**Circulation of hydraulics in Backhoe Loaders :**



**(CYCLE OF MANUFACTURING UNIT  
AT BALLABHGARH PLANT)**



## **Cycle of manufacturing unit :**

### **Logistics to fabrication :**

- *First of all, the machined sheets & pre-build parts (e.g., gear assy. Parts, rear axle assy. Parts & engine etc.) are brought in the logistics area. These parts are given by different vendors set by the company, (e.g., Engine by Kirloshkar etc.)*

*Then, according to the requirements :*

- *Metal sheets from which main frames, rear frames, Boomers/Dippers are to be welded are moved to fabrication shop.*
- *Engines are moved to skid sub-assembly line and the gears & rear –axle parts are moved to transmission line.*

### **Fabrication Shop :**

- *In fabrication shop, welding of different parts of (3DX Backhoe loader), the product which is made are done and then after their machining, finishing, surface smoothing etc. are done. After machining, the machine parts are moved to paint shop.*

### **Paint Shop :**

- *In paint shop, all the components parts are moved and painted, then the painted parts are moved to main frame assembly line.*



### **Main Frame Assembly Line (M-Line) :**

*The machine parts from paint shop are brought to the main assembly line with the help of EMS (Electric Monorail System) & cranes.*

- *This line has 10 zones ,for each zone certain workload is divided.In this line all the assembling of the main frame is done.Then,this assembled main frame is moved to the backhoe assembly line with the help of cranes & EMS system.*

### **Backhoe Assembly Line (A-Line) :**

- *At the backhoe assembly line,skid is dropped from the skid sub assembly line.*

**Skid Sub-Assembly Line** : *Assembled gear box & rear axle from **transmission line** are moved to skid sub-assy. Line.Here, the engine is connected to the gear box & rear axle.Thus (skid=Engine + Rear axle + gear box).*

- *The main frame is then dropped on this skid and,then after the process to process assy. of backhoe starts.*
- *The main assembly line (A-Line) has 22 zones for each zone certain workload is divided , just likewise in the main frame assy. line.*
- *The assembled Backhoe is then moved over to twin-slat line.*

### **Twin-Slat Line :**

- *At twin-slat line firstly the booms & dippers coming from the Boom/Dipper Sub-assy. line is attached to the machine and then the different oil filling process in the machine is done.*

### **PDI AND TESTING ZONE :**

- *The backhoe after being assembled in previous zones is moved to the PDI and testing zone in which the full range of machine functioning (i.e., working of all the parts of the machine; missing of any part, bolts or nuts; dismatching or defects in part of the machine ) is checked.*
- *Then after, the machine is greased, washed & again goes on for the 45 minutes trial run.*
- *After that, all the machines parts are checked and if any part is missing or defected, then the list of those parts are made. Then after, the machine goes on for the U.V. test by which the lower portion of the machine is checked , wether any leakage or defect in the hose and feed pipes are not.*
- *After making the list of all the defects and deformities , the machine moves in the reworking zone where all these remedies are solved.*
- *And, then after final washing, decal pastings & paint touch-ups , the machine is green signalled for dispatch.*

## **RAM PAINT SHOP**

- *It is the shop in which hydraulic rams as well as certain other components of the machinery parts are painted. These components are :*

*KPC, LEG, SHAVAL, LIFT, BOOM, DIPPER, CROWD, ST-RAM*

- *The raw material is fed into the loading zone where they are moved over EMS system which after then follows the cycle.*

- *The material which is pre-greased & oiled (to prevent corrosion) is passed through WATER RINSE-1, where it is bathed with a mixture of water mixed with chemical.*

*Chemical name : Deoxylite 54NC*

- *Then, the components are passed through activation zone and after that in the phosphating zone where phosphate coating is done on the surface of the components. The coating chemical is*

### ***Fixodiene 30-L***

- *Then, the components are moved in the reason water rinsing section-2 &*

- *Then, the component is moved to airblow-off zone in which the components are air blown so that no water molecules should stick on the surface.*

- *The component is moved to dry-off zone where it is heated in the oven, heating temperature maintained at 62 degree celcius and 1 atm. Pressure. In this zone the components are fully dried.*

- *The component is moved to masking zone where masking of holes are done to prevent the inflow of paint in the bores.*

- *Then, the component is moved to primer booth blower where the component is coated with the primer.*

- *The components are then moved to top-coat booth blower where final coating of the paint is done and then the components are moved in the baking zone where the components are baked in the oven having temperature in the range of (90-95) degree celcius.*

*Here, the paint on the components surface's are baked.*

- *The components are then unloaded in the unloading zone and then prepared to move to different sections of the manufacturing lines.*

# **FABRICATION SHOP**

## **1.Boom Cell :**

*3DX Boom is assembled and welded in this zone.In this zone manual welding is*

*Done with the process used is gas welding.*

## **2.Rear Frame Cell :**

*Rear frame parts are assembled,welded and machined to give smoothness &*

*Finishing.*

## **3.Loader Tower Robotic Cell :**

*The parts of the loader tower are brought,assembled,tacked & then welded in this zone with the help of robotic welding.After which manual welding & machining of those parts are done which can't be done with the help of robo welding.*

## **4.Loader Tower Boring Cell :**

*In this zone, mounting holes of loader tower is machined & fabricated with the help of CNC machine.*

## **5. Press Shop :**

*Mainly in press shop, the various components parts are pressed with the help of different machines fixed here such as*

- *Bevelling machines which cuts chamfers.*
- *Embossing machines*
- *Radial Drilling Machines*
- *Hydraulic Press 1*
- *Hydraulic Press 2*

*To make their surface leveled.*

## **6. Main Frame Welding Process :**

- *Different parts of the main frame are assembled or arranged by tacking them in main frame tacking fixture cell.*
- *Then, it is pre-welded in pre-welding zone where simple welding spots are done on the main frame.*

*Then, the main frame is moved to*

- *Manual welding shop where those parts are welded which can't be welded in Robotic cell.*

- *Then, the main frame fixture is moved to Robotic cell where there are two stations.*

*Station 1*

*Station 2 for robotic welding to take place. Thus, the final main frame fixture is obtained.*

### **7.Boom/Dipper Robotic Welding :**

*In this zone,robotic welding of boom/dipper is done in which those parts are welded which was left after manual welding.*

*After this ,boom/dipper are moved in boom/dipper machining area where they are machined and then collected in the storage area.*

*Each & every component after fabrication are stored in fabrication business unit(Fixture storage) after which all components with main frame,boom/dipper is moved in the paint shop where they are painted and then moved to main frame assembly line.*

## **TWO WAY CNC HORIZONTAL BORING MACHINE :**

*Designed for : Boom/Dipper*

*Output : 25 sets/shift*

*Payback Period : 1 year*

- The machine has automatic computer numerical control (CNC) operation except component load/unload.*
- The two components are loaded in dedicated fixtures fitted on two linear travelling tables which are alternately taken for machining.*
- Two concentric tools fitted in rotating spindles machine each bore simultaneously from either side half way down the length. Each bore is finished in two stages –Rough and finish.*
- One after the other bore is presented to spindles by movement of machine tools.*

### **Salient Specifications :**

- Two way horizontal boring machines fixed columns.*
- CNC Controller : Siemens 840D*
- Taper Spindle : HSK 100A*
- No. of Spindles : 2*
- Spindle Speed : 40-4000 RPM*
- No. of tables/pallets : 2*



- *No. of ATC/No. of tools in each ATC* : 2/24
- *Bed Size* : 19 metres
- *Cycle Time (set)* : 18-25 minutes
- *Components machine/Shift* : 25 sets
- *CP (booms) achieved in trials* : 1.7-2.25
- *CP (dippers) achieved in trials* : 1.8-4.16

**Function of this machine :**

*Precision machining of mounting holes of fabricated booms and dippers.*

## **ASSEMBLY LINES :**

### **Main Frame Assembly Line (M-Line ) :**

#### **ZONE M1 : Main Frame Drop**

- *Pick main frame*
- *Drop main frame on M-line*
- *Pick adjuster plugs from bins & Place on mai frame*
- *Pick pads & legs from bins & place it on main frame*
- *Pick pneumatic gun & fix adjuster plug*
- *Pick rivet gun from stand & fasten rivets with rivet guns of M8 &M10 size*

#### **ZONE M2 : Leg Fitment Zone**

- *Pick leg ram from trolley & place it on outer leg.*
- *Pick pivot pin from trolley*
- *Place in aligned hole in outer leg & inner leg*
- *Pick leg ram from trolley & palce it on rear frame*
- *Pick pivot pins from trolley & fix leg in place with pivot pins*
- *Pick circlip from bin,pick circlip plier & lock pivot pin in place with the circlip.*

### **ZONE M3 : FRONT AXLE FITMENT**

- *Pick front axle from trolley & place it on main frame*
- *Pick pivot pins & shims from trolley*
- *Align hole of front axle & axle yoke,insert pivot pin in the hole*
- *Pick bolt & nut from the bin,lock pivot pin in place with bolt & lock nut.*
- *Pick battery gun,socket & nut runner.Tighten the bolt*
- *Pick cover plate from bin,Pick screws,battery gun & socket.Tighten the screws*
- *Pick loader feed pipe from trolley.Place it on main frame*
- *Pick hoses from trolley,join the hoses to loader feed pipe on each side*
- *Pick torque wrench.Tighten the adaptor to main frame from usig torque wrench*
- *Pick grease nipple from bin*
- *Fasten grease nipple to adaptor using nut runner.*

### **ZONE 4 : STONE GUARD FITMENT**

- *Pick left & right hand stone guards from trolley.Place it on main frame*
- *Pick bolts,nuts & washers from bins.Pick battery gun,socket & nut runner*
- *Fasten stone guards in place with the help of bolts & nuts*

### **ZONE 5 : VALVE BLOCKS**

#### ***Loader hoses fitment :***

- *Pick hoses from trolley.Place it on main frame*

- *Pick hoses clamp from bin.Place it on main frame*
- *Pick battery gun,socket,nut runner.tighten hoses in place using battery gun*

### **LVB FITMENT :**

- *Pick resilient mount from bin.Place it on main frame*
- *Pick LVB from trolley.Place on resilient mounts*
- *Pick lock nuts from bins.Pick battery gun,socket.Tighten the LVB with lock nuts using battery gun*
- *Pick torque wrench.Join hoses of LVB to loader feed hoses.*

### **EVB FITMENT :**

- *Pick EVB from trolley.Place it on main frame*
- *Pick bolts,nuts & washers from bins.Place it on EVB*
- *Pick battery gun,socket & nut runner.Tighten the EVB using battery gun*

### **ZONE 6 : HOSES/PIPES**

- *Pick hoses from trolley.Place it on main frame*
- *Fasten two hoses on EVB to pipe rear return*
- *Fasten hose from LVB to EVB.Fasten hose to leg ram on both sides*
- *Fasten 4 hoses to EVB.Place it in retainer via right house guide*
- *Fasten 5 hoses to LVB.Place it in retainer via right house guide*
- *Place both retainers.Fasten hoses from front axle to orbital standing ram*
- *Remove cap from hoses & fasten it to loader feed pipes.Fasten hose from EVB to tank.Place cab mountings on main frame.*

## **ZONE 7 : FUEL TANK FITMENT**

- *Pick fuel tank from trolley.Place it on main frame*
- *Pick screws,washers from bins.Place on fuel tank.Pick pneumatic gun,socket*
- *Tighten the tank into place*

## **ZONE 8 : HYDRAULIC TANK FITMENT**

- *Pick hydraulic tank from trolley.Place it on main frame*
- *Pick screws ,washers from bins.Place it on the hydraulic tank*
- *Pick pneumatic gun ,socket & tighten the tank into place*

## **ZONE 9 : KPC FITMENT**

- *Lift KPC sub assy.Place it on main frame*
- *Pick upper & lower lock washers from bins.Tighten the locks to KPC*
- *Align one hose from EVB to right hand hydraulic clamp T-joint*
- *Pick torque wrench.Tighten hose using wrench*
- *Align hose both sides from hose retainers through KPC slew ram pipe to join with slew ram pipe in KPC*
- *Fasten hose from EVB to right hand upper hydra clamp adaptor*
- *Fasten hose from right hand upper hydra clamp to left hand lower hydra clamp*
- *Connect slew ram hoses in KPC from small hoses in hose retainer.*

## **ZONE 10 :**

- *Main frame loading to move it on main assembly line through EMS & cranes.*

## **MAIN ASSEMBLY LINE (A-Line ) :**

### **ZONE 1 & 2 : SKID DROP**

- *Pick skid from fixture & place it on conveyor*
- *Pick parking brakes from trolley*
- *Pick pneumatic gun,nuts,bolts & shuns from bin.*
- *Fix parking brake to rear axle.*

### **ZONE 3 & 4 : MAIN FRAME DROP**

- *Unload main frame from hoist & place it on conveyor.*
- *Pick bolts,nuts & washers from bins.Place it on main frame.*
- *Bring auto shut off tool to position.Fasten the rear axle to m/f using bolts & nuts*
- *Pick yoke plate from trolley.Place on gear box.*
- *Pick bolts,nuts,washers from bins.Pick pneumatic gun,nut runner.*
- *Fasten yoke plate to gear box using the bolts,nuts.*
- *Pick bolts,nuts & washers from bin.Fasten yoke plate to m/f using bolts,nuts.*

## **ZONE 5 : DRESS UP**

- *Pick hose from trolley.Pick torque wrench.*
  - *Attach one end of hose to return feed pipe and another to hydraulic cooler using wrench*
  - *Connect retur hose from EVB to hyd. Tank already placed on m/f using torque wrench.*
  - *Fasten the hose from transmission to cooler.Pick hydraulic section hose from trolley.Pick jubilee clip and worm drive clips from bin.*
  - *Attach one end of hose to hyd. Tank and other to pump using the clips*
- Connect pressure sensor.*

## **ZONE 6 : AFTER DROPPING ELECTRICAL FITMENT**

- *Fasten hoses from m/f to transmission.*
- *Fasten hoses from hydraulic tank to check valve*
- *Fasten hoses from return feed pipe rear side to exc. Return pipe.*
- *Lift hose to connect loader valve back to hydraulic pump*
- *Place cable tie from yoke late to conveyer to engine*
- *Pick battery gun & socket.Open the nuts of starter & alternator.*
- *Connect harness with starter & alternator*
- *Pick battery gun & socket.Connect +ve cable with starter on one side and the other end on the battery side.Tighten the –ve harness.*

- *Connect m/f harness with alternator connector*
- *Connect m/f harness with oil pressure switch connector*
- *Connect m/f harness with transmission switches for reverse & forward & connect with transmission switch and one with speedometer switch.*

## **ZONE 6 & 7 : ELECTRICAL FITMENT & RADIATOR/T. COOLER**

- *Pick horns from bins.Pick on main frame.*
- *Pick setpins,std nts,washers & spring washers from bin.Pick battery gun & socket*
- *Fix horns using washers & nuts.Pick jubilee clip & gun.*
- *Fasten the hose from tank to engine using the clip & the gun*
- *Route the hose through diesel tank bend to engine over flow pipe.*
- *Pick gear lever.Place on transmission keeping angle on R/H side.*
- *Pick battery gun,socket.Tighten the lever using the gun*
- *Pick hose from trolley.Assemble with clip on water temperature switch connector*
- *Tighten one end.Pick jubilee clip,battery gun.Fasten the hose using clip & gun*
- *Place hose b/w engine & radiator .Pick rubber,grommet.Make dipstick assy.*
- *Mount rubber grommet & dipstick assy on gearbox.Assemble dipstick on transmission using clamp & bolt.*
- *Pick mounting bracket.Fasten the bracket on the engine*
- *Pick air cleaner.Fasten the air –cleaner on engine using bolts.*



## **ZONE 7 : COOLING PACKAGE 1 & 2**

- *Pick mud filter & sediment from trolley.Place it on main frame.*
- *Pick bolts from bins.Attach both filters using bolts.*
- *Pick torque wrench.Fasten the hose from engine to filter using the wrench.*
- *Fasten the hose from sediment filter to mud filter using the wrench.*
- *Fasten the hose from mud filter to diesel tank using the wrench.*
- *Lift cooling package assy.Place it on m/f.*
- *Pick bolts,washers & lock nuts from bin.Pick batrey gun ,socket & spanner.Fasten the assembly using bolts & nuts.*
- *Pick jubilee clip.Fasten the hose bend to radiator using the clip & the gun.*
- *Pick bolts,washers & nuts from bin.Pick battery ,socket & spanner.*
- *Fasten the transmission & hydrauic cooler using the bolts & nuts.*

## **ZONE 8 : FRONT END**

- *Pick battery & mat from material feed conveyor.Place it on main frame.*
- *Pick battery from trolley.Place on all the levers*
- *Pick knobs from bins.Place it on lever & tighten the knobs with nuts.*
- *Join all the knob cable with harness connectors.Pick brake fluid reservoir.*
- *Open cap,put splash guard & tighten the cap.*
- *Pick bracket & place it on reservoir.Pick bolts,washers & nuts from bins.*
- *Assemble brackets to reservoir using nuts ,bolts.*

- *Pick assembly from tray & place it on main frame.Pick bolts,nuts & washers from bin.Pick battery gun,socket & nut runner.Mount the reservoir using bolts,nuts.*
- *Pick bumper from mat conveyor.Place it on main frame.*
- *Pick hack screws from bin.Pick battery gun,extension socket.*
- *Fix bumper in place using the screws.Pick yellow plugs from bin & place on the bumper.*
- *Pick grill housing from mat conveyor.Place it on main frame.*
- *Pick bolts,nuts & washers from bin.Pick battery gun,socket.*
- *Pick housing in place using the nuts,bolts.Pick grommets & maxifuse from bin.Place grommet on top of housing manually.*
- *Fix maxifuse to harness above R/H clamp.*
- *Pick bonnet stay,springs & split pins from bin.Assemble the parts into grill housing.*

## **ZONE 9 : LIFT RAM FITMENT**

- *Pick lift ram from trolley.Place it on loader tower*
- *Pick retaining collars,nuts & bolts from bin.Place on pivot pin*
- *Fix in place using nut & bolt.Pick torque wrench.*
- *Connect the hoses from lift ram to m/f using the wrench.*
- *Pick hose,jubilee clip from bin.Assemble with pre-cleaner pipe in main frame & air pre-cleaner using battery gun.*
- *Pick silencer from mat feed conveyor.Remove masking from engine exhaust manifold & keep yhe hardware for the assembly.*

- *Assemble the silencer on manifold one side & other side on fuel sedimentation filter bracket.*
- *Tighten silencer on engine with engine manifold by tightening 2 bolts first & then top 2 bolts using battery gun.*

### **ZONE 9 : LEVEL LINK FITMENT**

- *Pick level link from trolley. Mount on pivot pin already placed on trolley.*
- *Pick safety strut & T-bolt.*
- *Mount the strut on the link using the T-bolt.*
- *Pick collar & bolt from the bin. Place the collar on the pivot pin using bolt, lock nut.*

### **ZONE 10 : CHASIS NUMBER**

- *Bring punching machine to the main frame.*
- *Fix it & engrave the chasis no. on it*

### **ZONE 11 & 12 : LOADER ARM**

- *Bring down loader arm from EMS loop. Align its rear end with loader tower upper hole.*
- *Pick pins & shims from bin. Fasten the loader arm to loader tower using the pivot pin, shim*
- *Insert collar & bolt in pin. Pick bolts & nuts from bin. Fix pin in place using nuts & bolts. Align hole of level link & loader arm.*

- *Pick pin & insert in hole b/w level link & arm*
- *Fix pin in place by inserting collar, nut & bolt.*
- *Down the crane & remove the tackle for ram rod end both sides*
- *Insert lift ram b/w links of loader arm on both sides by using special rods for alignment.*
- *Pick bolts & nuts from bins. Pick pivot pin from bin.*
- *Place pins in the aligned hole. Fix pin in place using the nuts & bolts.*
- *Tighten all the nuts & bolts with battery gun, nut runner .*
- *Release the tackle & front side after making loader arm fully down and send for EMS loop.*

### **ZONE 13 : BONNET FITMENT**

- *Pick bonnet from material feed conveyer. Place it on table.*
  - *Pick bonnet hinge, washers ,bolts & nuts from bins. Place on table.*
  - *Assemble all the parts to the bonnet . Pick battery gun, nut runner .*
  - *Tighten the nuts, bolts using the gun. Lift the bonnet.*
  - *Place it over shroud on one side & grill housing on the other.*
  - *Pick bolts, washers & nuts from bin. Assemble the bonnet in place using the bolts, nuts.*
  - *Pick battery gun , socket & nut runner. Tighten the nut, bolts using the gun.*
- Hold bonnet with stay.*

### **ZONE 13 : PRE-CLEANER SUB-ASSEMBLY**

- *Pick pre-cleaner stud body from bin.*
- *Fix the body pre-cleaner to stud by pressing tightly.*
- *Pick top pre-cleaner. Place on body pre-cleaner.*
- *Pick base pre-cleaner from bin. Attach it to stud manually.*
- *Pick jubilee clip from bin. Place on bottom of the stud.*
- *Pick jubilee clips. Fasten it using the gun.*

### **ZONE 14 & 15 : CAB FITMENT**

- *Lift cab from mat feed conveyor .Place it on main frame.*
- *Pick nuts,bolts & washers from bin. Fix them in their aligned holes.*
- *Tighten the nuts ,bolts using the nut runners.*
- *Pick side panels from trolley. Place it on main frame.*
- *Pick bolts,nuts & washers from bin.Pick battery gun , nut runner.Fix panels in place using battery gun & nut runner .*
- *Connect hoses from master cylinder to brake oil cup.*
- *Pick up gun to tighten the hoses. Push button to start cycle*
- *Remove gun after completion of the cycle.Place gun bolt on the machine.*

### **ZONE 16 & 17 : CAB INTERNAL**

- *Pick floor mat from trolley.Place on L/H & R/H side on the cab.*

- *Check electrical in the cab .Check lights from head lamp, indicators.*
- *Pick cab side cover from trolley.Pick battery gun socket.*
- *Pick bolts,washers from bin. Pick panels in place using bolts,nut & washers.*
- *Pick cab side covers from trolley. Pick battery gun socket.*
- *Pick bolts,washers from bin. Fix the panels in place using bolts & washers.*
- *Put the battery cable on the battery. Pick battery cover from trolley.*
- *Pick bolts, washers & flynut from bin. Place the cover on the battery using the fly nuts etc.*
- *Pick grills from trolley. Place on the front end.*

### **ZONE 18 : BRAKE BLEEDING**

- *Remove gun & press cycle abort PB. Flush cycle. Press cycle start.*
- *Evacuation, Excess vacuum, Leak test ,Revacuum.*
- *Fitting operation & leveling.*

### **ZONE 19 & 20 : TYRE FITMENT**

- *Pick rear tyre sub –assy. Place them on rear axle.*
- *Pick front tyre sub-assy. Place them on rear axle.*
- *Pick nuts from bin.Place on rear & front axle. Fasten tyres to both the axles using nuts & bolts & pneumatic gun.*

## **TWIN-SLAT LINE :**

*•Pick trolley having boom & dipper.Place the boom & dipper on dedicated stand.*

*Join hoses of boom & dipper.*

*•Pick bolts, collars, shims & pivot pin from stand & bin.*

*• Connect boom & dipper using the pins. Fix them using a hammer. Join ram of boom using to dipper using the pivot pin.*

*• Connect the remaining hoses to KPC assembly.*

*• Fill the oil in five respective oil tanks*

*DIESEL, ENGINE, COOLANT, TRANSMISSION, HYDRAULICS.*

## **PDI AND HOT TEST ZONE :**

### **BAY – 1 :**

#### **BUCKET FITMENT ZONE**

*Loader buckets as well as excavators buckets are brought in this zone to be attached to the **3DX backhoe loader**.*

#### **Excavator buckets :**

*These are first attached to rear portion through pivot pins.*

#### **Loader buckets :**

*These are attached to the front portion through pivot pins.*

*Then, the working of the buckets are tested in this zone. The nuts of the king post carriage are adjusted in such a way that the KPC arrangement could easily slide along the line of the machine.*

#### **PRE-RECTIFICATION ZONE :**

*In this zone, all the fastenings of the machines are checked whether some fastenings are missing, tightly fitted or loosely fitted, then all the errors are rectified.*

*Further on, all the oil canisters are kept here such as :*

*COOLANT    ENGINE OIL    TRANSMISSION OIL    DIESEL    HYDRAULIC OIL*

*If in any tank, the oil is less than the required oil is filled according to the need.*

*Then the machine goes in the greasing zone where different portions are greased using CASTROL grease.*

**\* Hydraulic dye is filled in the hydraulic tank to inspect any leakage in the tank.**



## **WASHING BAY :**

*Washing chemical : HENKEL-P3T768*

*With the help of this chemical the washing of the hole machine is done.*

*After that, the machine goes for a 45 minutes trial run in which it is used harshly to check all the functioning s of the machine.*

## **BAY – 2 :**

### **DYNAMIC AND HUMPTTEST ZONE :**

- Locate the machine on roller testing bench. Move the hydraulic platform (b/w the rollers ) downwards by pressing PB on electrical panel.*
- Operate the machine in first gear & then in second & so on. Observe any abnormal noises.*
- Apply sudden brakes & observe the status on electrical panel.*

*TOTAL CYCLE TIME OF THE PROCESS : 10 MINUTES*

## **BAY – 3 :**

### **INSPECTION ZONE :**

*Quality inspection is done according to the parameters set up by the company or quality control department.*

*\* UV testing as well done here in this zone.*

## **BAY – 4 :**

### **INSPECTION ZONE :**

*Reworking of machine of all the faults detected by the inspection zone at BAY – 3.  
is done here in this zone.*

## **BAY – 5 :**

### **FINAL TOUCH-UP :**

*After reworking the machine goes in for the final touches in different sections :*

*Washing BAY*

*PDI BAY – 1*

*PDI BAY – 2*

*DECAL PASTING*

*PAINT TOUCH UP BAY – 1*

*PAINT TOUCH UP BAY – 2*

*Major Rework BAY*

***PROJECT***

***REPORT***

# **TIME FOR STUDY MOTION :**

*This is the project based on time - to – time study of each and every worker working on the main frame line & assembly line for the manufacturing of a single machine.*

*In this project, a simultaneous time was to be taken based on the work load of a single worker working on the line.*

*For which , we have to take the individual time for a single worker depending upon the time he devotes in doing his work*

*Manually (by hand ) .*

*With the help of machine like crane as well as different torques*

*& the time he devotes in walking which comes under NVA (Non-value added ) work.*

*Thus , keeping in view all the above working parameters , we noted down each individuals time dividing everyone’s time in the three categories mentioned above . Thus, we came on the conclusion that*

*there are 38 workers on the assembly line which are casual & 37 workers on the assembly line which are permanent with each one’s individual time, which will be compared with the tact time of the machine & whatever methods to be adopted will be done to increase their efficiency as well as to increase the production line.*

# **STANDARD OPERATION PROCEDURE :**

*This is the operation which is the base of any manufacturing unit because it is the working parameter based on which the workers have to do their work to produce a single machine.*

*Standard operation procedure is a wholesome process in which the total processing of a manufacturing line comes under the scanner like picking up a single pin , to walking of the man to his designated platform , to movement of cranes from one position to another.*

*Thus , in standard operation procedure or so called (SOP) ,*

*Firstly, we had to study the whole processing of the JCB machine manufacturing from main frame line to main assembly line and then to twin-slat line.*

*And after that , studying the SOP of each & every sub-assemblies.*

*BOOM/DIPPER , LOADER ARM , SKID , KPC , HYDRAULICS.*

*Thus , after studying the each & every motion of the process , we have to modify & update the sop of the whole assembly line in which we have to see that*

*Wether , any operation or operator is left out or any operator is extra which can be sorted out or can be indulged into any extra work.*

*Thus , this was our project based on the STANDARD OPERATION PROCEDURE.*

# **TEMPERATURE STUDY OF THE WHOLE**

## **MANUFACTURING UNIT**

*In this project , we have to take the temperature of some specified zone of the whole plant on the daily basis with the help of a digital thermometer.*

*By taking the temperature of each & every zone , we came under the conclusion of the fatigue level under which different workers of the whole plants are working.*

*Thus , making a conclusion of the areas which are to be concerned in which the worker's fatigue level could be decreased.*

*The different areas in which temperature was to be measured were :*

<i>Main Frame Zone</i>		<i>Z21 &amp; Z22</i>	<i>32.4</i>
<i>M1</i>	<i>31.1</i>	<i>TWIN-SLAT LINE</i>	
<i>M2</i>	<i>31.0</i>	<i>T1</i>	<i>32.5</i>
<i>M3</i>	<i>31.1</i>	<i>T2</i>	<i>32.5</i>
<i>M4</i>	<i>31.2</i>	<i>T3</i>	<i>32.8</i>
<i>M5</i>	<i>31.3</i>	<i>T4</i>	<i>32.6</i>
<i>M6</i>	<i>31.5</i>	<i>T5</i>	<i>32.8</i>
<i>M7</i>	<i>31.2</i>	<i>T6</i>	<i>32.8</i>
<i>M8</i>	<i>31.0</i>	<i>T7</i>	<i>32.7</i>
<i>M9</i>	<i>31.0</i>	<i>B/D Sub-assy.</i>	<i>32.2</i>
<i>M10</i>	<i>30.8</i>	<i>Loader arm sub-assy.</i>	<i>33.2</i>
<i>Assy. Line</i>		<i>Skid assy.</i>	<i>32.3</i>
<i>Z1 &amp; Z2</i>	<i>30.9</i>	<i>KPC Sub-assy.</i>	<i>30.9</i>
<i>Z3</i>	<i>32.0</i>	<i>Gear box trans. line</i>	<i>32.9</i>
<i>Z4</i>	<i>32.0</i>	<i>Rear axle line</i>	<i>33.2</i>
<i>Z5</i>	<i>31.8</i>	<i>CNC</i>	<i>32.3</i>
<i>Z6</i>	<i>31.9</i>	<i>Fabrication Shop</i>	
<i>Z7</i>	<i>32.0</i>	<i>M/F Robo</i>	<i>33.2</i>

Z8	32.1	B/D Robo	32.2
Z9	31.8	Loader Tower Cell	31.9
Z10	31.9	SIP	32.7
Z11& Z12	31.8	Machining Area	33.2
Z13	31.6	Old Power House	31.1
Z14 & Z15	31.7		
Z16 & Z17	32.1		
Z18	32.2	LDC	30.9
Z19 & Z20	32.1	Ambient	40.1

***Thus ,we came under conclusion that area such as machining area , some sub –assy., & transmission line are relatively hotter than other zones . Thus , something is to be done there .***

# **WORK COMBINATION TABLE :**

## **Standard Work Combination Table - Definition**

*The Standard Work Combination Table combines human movement and machine movement based on takt time and is used as a tool to determine the range of work and work.*

## **Sequence for Human work and Machine work**

*The key notion for the elimination of waste and the effective combination of work on the shopfloor is the separation of machine work and human work. When we observe the work in which operators handle machinery, then that work can be classified into machine or human work.*

*Understanding the separation of human and machine work is the basis for understanding the interface between these two elements.*

*If operators are merely observing the machine working then this is the waste of "Waiting" and should be eliminated. which a team member is responsible.*

## **Human work**

*This refers to work that cannot be completed without human effort. For Example ,*

- picking up materials*
- putting materials onto a machine*
- operating the controls of a machine*
- manual slaving*



## **Machine work**

*This refers to work or incidental work that equipment, which has been started by human hand, automatically performs operations.*

- Milling
- Auto riveting / bolting
- Auto inspection (Hole probes) etc.

## **VA/NVA ANALYSIS – Perfect For Today’s Economy**

*Just about everyone knows that the economy is bad. Organizations are laying off employees by the tens of thousands, and realistically, most of the time this becomes just a numbers game. If we get rid of X number of people, it will impact the bottom line of the organization by Y amount.*

*Typically, this is not the case. Often organizations end up spending more or incurring additional waste as a result of staff reductions. Processes can become broken and often do not function properly because knowledgeable people have been let go, and the people that remain, do not know what to do. Confusion is rampant – with everyone wondering what needs to be done and how it will happen with fewer people. The word “reorganize” is everywhere; to the point where we are reorganizing so much, we never become organized.*

*This is where understanding the tools of Lean & Lean Six Sigma becomes invaluable. If companies want to reduce costs and waste in an organization, that is the heart of Lean and Lean Six Sigma.*

*One of the best tools that can be used is the Value Added/Non Value Added flow analysis. Upwards of 80% of most processes consist of non-value added activities. VA/NVA analysis looks at an entire process and looks at three key things for each activity:*

- *Is this activity something the customer is willing to pay for?*
  - *Storage, handling, extra steps, are all activities that add cost, time, and waste and the customer (external customer & internal business customer) do not want to pay for*
- *Is the activity done right the first time?*
  - *Rework, missing information, incorrect amounts, all add to waste internally*
  - *Call centers to answer questions, fix problems, not only add cost, but can cause customer frustration*
- *Does the activity add value or physically change the product or service?*
  - *There are many activities associated with processes that change absolutely nothing to the product or service – typically inspection is one of them, but approvals and other things of this nature also do not add to the product or service*

*To be a Value Added activity, all three of the above criteria must be met. Value added flow analysis looks at a complete end-to-end business process and analyzes each step of the process to see which steps are value added and which are not. This then leads to working to eliminate the non-value added work.*

*This is a much more practical and logical way to remove waste, than just removing people from the process.*

*Just reducing people only causes the organization to do the same work that is being done today – Value added and non-value added, but with less people. This is a perfect formula for failure.*

*What is necessary in today's economic climate is leadership understanding that the short-term removal of people is not as successful as the disciplined short and long term use of the tools of Lean and Lean Six Sigma to improve processes and improve profitability.*