# Single Piece Flow in Dressing Line by Providing MPT Checking Fixture

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***Abstract*: - Generally, testing fixture is device used to test the components of the product. Fixture is used as tools for positioning the components during quality checking by MPT process in dressing or finishing. In our project, we have given a change in the entire design and model of the fixture which is been used by the company. The design of fixture was made in such a way that it holds the components during MPT process with the help of the newly designed testing fixture. Here we are glad to take the task for reducing cycle time which in turn improves productivity & flexibility of an organization. Our objectives given by wheels India limited is to reduce cycle time after a long process of keen absorbing all problems & data gathered from machining shop of wheels India limited ,we found a solution for reducing cycle time.**

## I. INTRODUCTION

Wheels India Limited was established in the early 60s, as a joint venture between TVS and Dunlop UK. It is a leading manufacturer of automotive wheels and supplies to all major vehicle manufacturers in the country. The company has collaboration with Titan, the world leader in off-highway vehicle wheels. It produces wheels for all vehicle categories including passenger cars, utility vehicles, trucks, buses, agricultural tractors and construction equipment. More than 15% of its production is exported to North America, Europe, Asia Pacific and South Africa. Cutting-edge product development and process design allows the company to address high-volume markets, niche segments and customer-specific requirements. The company has manufacturing facilities at Padi, Pune and Rampur with a combined annual capacity of seven million wheels. With a workforce of 1585 people, turnover for 2004-05 was Rs 7,790 million (US$ 177 million…..Wheels India limited is the company promoted by the TVS group, India`s largest auto component manufacturers. Starting with a bus service in 1911, the TVS group has grown to become one of the largest business houses with business in two wheelers, vehicle dealership and logistics and auto components which had turnover of over USD 7 billion. Wheel India (established in 1962) is one of the largest steel wheel manufacturers in the world. The company had turnover of USD 375 millions coming from the segments of cars/UVs, commercial vehicles, tractors, single piece wheel and construction and earth mover's wheel. The company also manufactures air suspension kit for truck and buses with over 15% of its turnover coming from exports, particularly from the of earth mover equipments. It is truly a global player in the automotive industries. Wheels India started production of wheel for commercial vehicles in 1962 at our plant in Padi, Chennai. The company started the production of car and tractors wheels in Padi in1965. In 1972 the company made a foray into the construction equipment sectors with Hindustan motors (now CAT India). In 1982 the company opened its second facility in Rampur for tractor wheels. Wheels India entered the wire wheels business in 1988 and also entered the air suspension market under the brand "WIL RIDE". In 1988 the company opened a facility in Pune to cater to this growing automotive hub. This facility manufacturer's wheel for car, trucks and buses. The 2000s represented a decade for growing the company and 2000 marked its entry to the earth mover market with 35 and 45 inch wheels. In 2005 the company started manufacturing forged aluminium wheels to cater to the growing after market for truck and trailer manufacturers. 2007 marked the setup of new facilities in sripermbudur for Big EM wheels and bawal for car wheels. In 2009 the company started new facilities in pant nagar to cater to the growing truck and light commercial vehicle limited. Wheels India is the partner to various global OEMs like ford, Hyundai, tata, caterpillar, johndeere, komatsu, Hyundai heavy industries, case new Holland, tafe and Suzuki. The company has won various awards which stand as a testament to its "quality first policy" to name a few-CAT SQEP silver certification 2010. TPM awards and certification, Toyota supplier award for quality and cost 2009 and regional contribution award form Toyota in 2013 global suppliers convention. The company believes its future lies in partnering OEMs in their growth and providing service to match. Wheel India has launched after market brand. "TVS WIL GO" for catering after market in 2012.

## II. PRODUCTION SHOP

Wheels India limited indulges the world class technology as the input for their process, which contributes the making of India's top quality wheels which are carried various shops. They are

1. Rim line
2. Press shop
3. Machine shop
4. Assembly line
5. Dressing line

6. Shot blasting
7. Paint shop

*2.1 RIM LINE*

Raw material strip entering into the rim line shop and is converted into the rounded (coiled) shape by using coiling operation. Second operation closing is to reduce ovality in the component. Then the both the ends of the strip are joined by tack weld using arc welding operation. At last butt welding is done by automatically which ensure perfect joining of edges. Due to butt welding excess amount of flash are produced. Excess metals on the surface of rim (flash) are remove by flash cutting. The welded areas are grinded internally and externally in order to create surface finish. Then the grinded parts are expanded by the expansion process to ensure the correct dimension of radius of rim. After that the parts are contracted to form the required dimension. Then they are inspected by the MPT process.

*2.2 PRESS SHOP*

Loose flange feed into the furnace is heated above recrystallization temperature (723 degree) and gantry robots load the part into path of the hydraulic press. By using hydraulic press required shape forming is obtained. After pressing operation component is unloaded and kept in open atmosphere for normalizing process.

*2.3 MACHINING SHOP*

All the components coming from the rim line are enter into CNC machine for milling operation. Here all the component are milled according to their requirements. Except loose flange and disc all the other components required for wheel assembly enter into the machining. Loose flange and disc moved into the press shop and then it is move into the machining shop.

*2.4 ASSEMBLY LINE*

All the machined component are assembled sequentially in assembly shop. First, rim tack welding done on the component. Generally this operation done by MIG welding and then it moves with the help of air hoist for next operation(rim backup welding). Submerged arc welding is used to perform rim back weld. Then it moved for full welding. Here welding of the rim component are done with SAW. Due to sequence of welding operation temperature of the rim component heated up slightly. So cooling have to be done. Then linishing operation is done and valve holes are drilled. The assembled parts are combined with the disc using welding and bolt holes are drilled in the disc. At last ultrasonic testing is done to ensure the quality of the assembled component.

*2.5 DRESSING LINE*

In dressing shop the assembled component is grinded manually and burrs are removed. Then the dressed component is send for shot blasting and the small projections are removed by the impact force and comes out as a finished product. It gives a aesthetic look.

*2.6 SHOTBLATING*

Shot blasting is a finishing operation which is used to increase the compressive strength and to give shiny appearance to the component. Initially the components after grinding are loaded in the pallet and is sent through the shot blasting machine, Where the components are continuously hit by minute steel balls in various directions. Thus it gives good compressive strength to the component and increase its shiny appearance by removing the surface layer due to intendation caused by the balls.

*2.7 PAINT SHOP*

The wheels which arrive from the shot blasting operation are painted by controlled painting process. It is one of the most modern paint shop in the country and uses the environment friendly water based process for superior and lasting exteriors. A unique process management system is followed here which helps in deliver the product mainly in two colours yellow and orange. When the appearance is beautiful it raises the wheels value.

## III. STEPS IN PROBLEM FINDING

1. OEE for all components in dressing shop
2. Study the Time losses of arrangements for Magnetic Particle Testing of components in dressing shop

*OEE FOR ALL COMPONENTS IN DRESSING SHOP*

- What is OEE
- How to calculate OEE
- Benefits of OEE
- OEE measure of all components in dressing shop
- Improvement ideas of arrangements for Magnetic Particle Testing of components in dressing shop

*What is OEE?*

It's easy to understand that the ***OEE – Overall Equipment Effectiveness Index*** of a piece of equipment in a given time is nothing else than the ratio between the Valuable Operating Time and the Active Time. By definition, **the OEE is a measure of the value added to production by a certain machine ina certain period of time**. If that machine was operating 100% of the Active Time without being subject to any Loss, the Valuable Operating Time would coincide with the Active Time: the entire Active Time would be devoted to add value to production.

*HOW TO CALCULATE OEE?*

Now we have the 3 main OEE rates for determining Class A Machinery:

- AVAILABILTIY
- PERFORMANCE RATE (PR)

- QUALITY RATE (QR)

We can calculate the Overall Equipment Effectiveness Index (OEE) of a machine in a given period of time with the product of the 3 Rates:

OEE = OVERALL EQUIPMENT EFFECTIVENESS = A x PR x QR

Availability = operating time/available time

PR=output * ideal cycle time/ operating time

QR=(total parts run –total defects)/total parts run

*BENEFITS OF OEE*

1. EQUIPMENT: Reduced equipment downtime and maintenance cost and better management of the equipment life cycle
2. PERSONNEL: Labour efficiencies and increased productivity by improving visibility into operations and empowering operators
3. PROCESS: increased productivity by identifying clamp design.
4. QUALITY: increased rate of quality, reduced cycle time.

## IV. IMPROVEMENT IDEAS OF ARRANGEMENTS FOR MAGNETIC PARTICLE TESTING OF COMPONENTS IN DRESSING SHOP

In order to reduce the cycle time of dressing process, a new fixture is designed for magnetic particle testing process in dressing shop. Before implementing our idea, they were testing the components by magnetic particle testing manually. It takes more time and reduces production rate also. The new design reduces the cycle time of dressing shop.

In this fixture, the mechanism can be done semi automatically by the operator itself. Due to implementing this fixture, it improves the quality and reduces man power.

We concentrate fully to reduce the cycle time during MPT process in dressing shop, so we gave an idea of implementing "**SINGLE PIECE FLOW IN DRESSING LINE BY PROVINDING MPT CHECKING FIXTURE"**

### *4.1 ANALYSIS OF CYCLE TIME OF MPT PROCESS IN DRESSING SHOP:*

In the dressing shop, the worker taking the components likes loose flange and BSR from the path line and placing it on the floor. Then the worker doing the MPT process on the components. This is the progress undergoing in dressing shop at present. There is variety and various sizes of wheels are produced in wheels India according to their customer requirement. After being manufactured in the press shop, machining shop and assembly shop, these wheel components enter the dressing shop for finishing operations. After finishing by grinding operation, the components must be checked for quality. The worker will pick and place the components on the ground. By analysing this pick and place operation, it is found that the cycle time is more for loading and unloading of MPT process. Due to this, the production rate is slower. The root causes for this lagging process is described below.

### *4.2 CYCLE TIME IN FINISHING OPERATION (BEFORE):*

*i) ANALYSIS FOR LOOSE FLANGE:*

| ACTIVITY | TOTAL TIME (sec) |
|---|---|
| Component arrival | 20 |
| picking of component | 15 |
| Placing the component in the dressing line | 15 |
| External Grinding the component | 28 |
| Rotating the component | 20 |
| Internal grinding the component | 28 |
| Marking wheel and modal number in the component | 8 |
| MPT process | 30 |
| Unloading | 20 |
| **TOTAL TIME TAKEN** | 184 sec |

TABLE 4.1 CYCLE TIME IN DRESSING OPERATION FOR LOOSE FLANGE

*ii) ANALYSIS FOR BSR*

| ACTIVITY | TOTAL TIME (sec) |
|---|---|
| Component arrival | 25 |
| picking of component | 20 |
| Placing the component in the dressing line | 10 |
| External Grinding the component | 20 |
| Rotating the component | 15 |
| Internal grinding the component | 25 |
| Marking wheel and modal number in the component | 8 |
| MPT process | 28 |
| Unloading | 15 |
| **TOTAL TIME TAKEN** | 166 sec |

TABLE 4.2 CYCLE TIME IN DRESSING OPERATION FOR BSR

By using analysis data, the time taken for MPT process is longer for both loose flange and BSR.

### *4.3 CAUSES FOR THE LONG CYCLE TIME:*

The major causes for the long cycle time are-

- Picking and placing the component on the ground
- Single man power operating for whole process (picking and placing and MPT process)

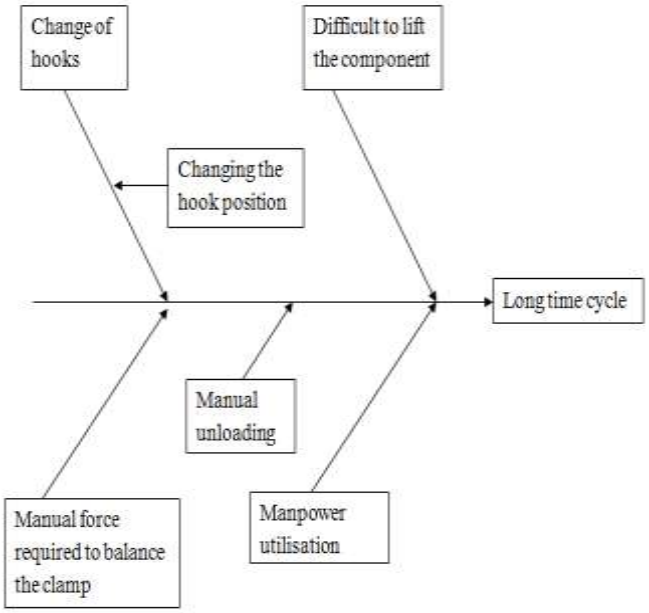
*4.4 CHANGE OF DRESSING LINE:*

The dressing line doesn't provide any fixture for MPT process. The worker takes the components like loose flange and BSR from dressing line with the help of hook and placing it on the floor. These hooks are hung down in the chains and are controlled by the pneumatic mechanisms. For lifting the components of varying thicknesses, the position of the hooks hung in the chains must be frequently altered. This consumes much time and results in the delay of the working process.

*4.5 MAN POWER:*

The cycle time of the pick and place operation of the various components also includes manpower. Manpower can be defined as the process of the work input delivered by the man by using his manual power in the operation. In the pick and place operation, the worker has to arrange the component such that the component can be lifted by the clamp easily and can be finished in the dressing line. So, this requires more time and energy to accomplish.

*4.6 ROOT CAUSES FOR THE LONG CYCLE TIME (before):*




## V. SOLUTION FOR REDUCING CYCLE TIME IN DRESSING

By analyzing OEE data for all process in the dressing shop floor, we came to a conclusion that the productivity would increase if the dressing line is changed for MPT process. It took seven and half minutes for MPT process. In order to reduce changeover time for loading/unloading process, we derive a solution which is listed below

- Introducing new fixture for MPT process
- Introducing Key push/pull Mechanism

*5.1 INTRODUCING NEW FIXTURE FOR MPT PROCESS:*

` In dressing line there is no setup for MPT process. This could be a major problem for lifting the wheel components and doing MPT process. Due this setup, the worker manually lifts the components. It takes more time and reduces production rate. To overcome the above problem we introduced the fixture in dressing line. With the help of that fixture, the worker needs not to lift the components and he can do MPT process in dressing line itself.

*5.2 INTRODUCING KEY PUSH/PULL MECHANISM:*

In order to reduce the cycle time during the dressing process, the fixture with push/pull mechanism is introduced in the line. The mechanism helps to carry the components simultaneously one by one, without wasting the time. The key works in such a manner, when it is pushed and it helps to lift the components from the dressing line and when it is pulled and it place the components on the dressing line itself. This key mechanism can be done manually by the operator itself.

*5.3 ABOUT MILD STEEL*

Mild Steel is one of the most common of all metals and one of the least expensive steels used. It is to be found in almost every product created from metal.It is weld able, very durable (although it rusts), it is relatively hard. Here bolts of gripper are made up mild steel of having less than 2 % carbon it will magnetize well and being which isinexpensive can be used in most projects requiring a lot of steel.

Being a softer metal and its inherent properties make fatigue on the material and creep stress .In fact, at the most, steel can have about 2.1 percent carbon. Mild steel is one of the most commonly used construction materials. It is very strong and can be made from readily available natural materials. It is known as MS.
Mild steel usually contains 40 points of carbon at most. One carbon point is .01 percent of carbon in the steel. This means that it has at most .4 percent carbon. Most steels have other alloying elements other than carbon to give them certain desirable mechanical properties. 1018 steel, a common type of mild steel, contains approximately .6 percent to .9 percent manganese, up to .04 percent phosphorus, and up to .05 percent sulphur. Varying these chemicals affects properties such as corrosion resistance and strength.

*5.4 PHYSICAL PROPERTIES: STRENGTH*

- Mild steel is very strong due to the low amount of carbon it contains. In materials science, strength is a complicated term. Mild steel has a high resistance to breakage.
- Mild steel, as opposed to higher carbon steels, is quite malleable, even when cold. This means it has high tensile and impact strength. Higher carbon steels usually shatter or crack under stress, while mild steel bends or deforms.

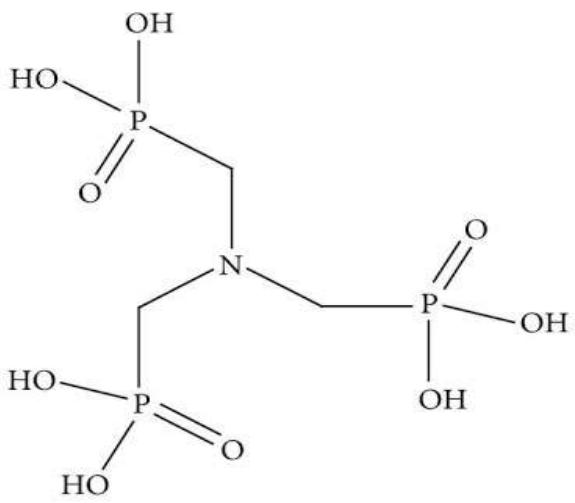



FIGURE 6.1 Mild steel structure & micro structure

*5.5 BENEFITS OF NEW FIXTURE:*

- Reduces worker motion loss
- Ease to material handling
- Reduces changeover time
- Rigid and fixed frame on insert

## VI. VALIDATION OF THE PROJECT

*6.1 INTRODUCTION OF MPT FIXTURE:*

It is the process of introducing the fixture for MPT process in dressing line in order to make it easier to achieve the process of pick and place operation on the components like loose flange and BSR.

*6.1.1 BEFORE INTRODUCTION OF MPT FIXTURE:*

Before the process of the introduction of the MPT fixture, the existing dressing line doesn't contain any type of fixture to lift components. The worker was lifting the different components like loose flange and BSR by the usage of the hooks attached at two different levels. Then the worker place it on the ground and do the MPT process.

*6.1.2 AFTER INTRODUCTION OF MPT FIXTURE:*

After the introduction of new MPT fixture, it makes the work of the MPT process easier such a way that the fixture can be used to handle the components like loose flange and BSR. This not only makes the MPT process easier but also reduces the work load to the man as the worker has to lift the components from the dressing line. By this new design, the work load can be reduced.

## VII. FABRICATION PROCESS

*7.1 FABRICATION OF THE NEW FIXTURE:*

The fixture that is inserted between the MPT process of the is manufactured by the following operations:

- GAS CUTTING
- WELDING
- GRINDING
- DRILLING & THREAD TAPPING

*7.1.1 GAS CUTTING*

In the gas cutting process, the metal rods of longer length are cut into required size which is shown in tabular column. The gas cutting process is also known as oxy – fuel cutting in which the fuel gases and oxygen are used to cut the metals. Here, a torch is used to heat the metal to its kindling temperature. Thus, the metal burns into its oxide and flows out as slag. Thus, the required shape is cut over the metal to form the jaw and joint portions.

The size of metal pieces is given below:

| **Size (length * thickness)** | **No.** |
|---|---|
| 1260*5 | 2 |
| 270*5 | 2 |
| 370*5 | 2 |
| 1280*5 | 2 |
| 310*5 | 1 |
| 880*5 | 2 |
| 610*5 | 2 |
| 720*5 | 2 |
| 2000*10 | 3 |
| 440*5 | 2 |
| 225*5 | 2 |

*7.1.2 WELDING:*

In the arc welding process, the metals are welded together in exact positions by using the arc welding. The plasma arc is used to weld the components so that the materials are bonded

together permanently. The arc welding process delivers a plasma arc by which the materials get heated to a very high temperature and are welded by melting.

In the welding process, the metal pieces are welded according to our design which is already shown in before chapter. In our design, welding is the major fabrication process.

*7.1.3 GRINDING:*

Grinding is an abrasive machining process that uses grinding wheel as the cutting tool. This operation produces very fine finishing with accurate dimensions. Thus the chips and additional surfaces produced on the clamp while welding are removed finely by the use of the grinding machine. By grinding, the material becomes smooth with fine surface finish by which the worker can handle the clamp easily. In the welding process, turned edge of the component is welded into the fixture of MPT process. So that the fixture have burr on welded area. Grinding process done on the welded a0rea of the component to remove burr and get surface finished. The grinding process is done such that the fixture is surface finished.

*7.1.4 DRILLING*

Drilling is the cutting process that uses a drill bit to cut a new hole or enlarge an existing hole of a circular cross section in solid materials. The drill bit is a rotary cutting tool with a multipoint. In the clamp, the drilling process is carried out to form the bolted joint such that the clamp jaw portion can be attached to the clamp body. The hole is made by the high speed drill and coolant is used to cool the drilled area as more heat will be generated.

## VIII. CONCLUSION

Customer today wants a variety of product in just the quantities they need. They expect high quality, a good price, and speedy delivery. These processes require a root cause and the cause is high productivity. The high productivity can be achieved when the time and man work are managed in an efficient manner. To do so, a new design for the fixture for MPT process used in the dressing shop for the pick and place operations was made and it was fabricated based on the design. Now that, the fixture can be named semi automated MPT fixture and as the name indicates, the fixture can pick and place or lift the different components like loose flange and BSR. Thus the operating time for the quality checking by MPT process is greatly reduced. This improvement ultimately increases the productivity and thus, the customer satisfaction can be achieved easily.

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