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Research Article

Low Volume Manufacturing Strategy for HVAC Assembly

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Abstract

At MAHLE Behr, there is a requirement to reconsider the production strategy for HVAC manufacturing of heavy duty commercial vehicles considering the changes that will take place after the advent of EURO VI. Presently, assembly for TATA Y1 LHD&RHD 24V and VECV LHD&RHD takes place on a single line. The demand for the HVACs of these vehicles isn't high enough to use mass production systems. This paper looks to find an alternative to traditional production systems and strategies with a view to improve productivity.

Keywords: *HVAC Assembly etc.*

1. Introduction

MAHLE Behr offers solutions for climate control and engine cooling in all types of automobiles from compact cars to upper class vehicles, from vans to heavy-duty commercial vehicles. – MAHLE Behr offers complete thermal management, perfectly matched to each vehicle. MAHLE Behr has the entire range, based on comprehensive system knowledge and offers complete systems modules, right up to individual components.

This paper deals specifically with the HVAC manufacturing of TATA Y1 LHD&RHD 24V and VECV LHD&RHD modules. Contrary to others, a single assembly line shares the load for manufacturing HVACs for both vehicles. The reason being that abri demand for these is very low as compared to others like Volkswagen, Nissan, Mahindra etc.

Modern day mass production systems involve electronics, logistic and computer software, mass production systems have become very easy to implement and are very cost effective. In MAHLE Behr, the 2 BIN SAP SYSTEM is used for large scale production.

For the manufacturing of heavy duty commercial vehicles' HVAC systems whose demand is not large enough to qualify for mass production, the above-mentioned techniques cannot be used the reason being that mass production systems are effective only for high volume productions.

Thus we look at some of the techniques from Toyota Production Systems (TPS) like Just in Time (JIT), SMED Raw Materials progress, Work in Progress, Finished Process etc.

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Work in process (WIP), goods in process, or in-process inventory are a company's partially finished goods waiting for completion and eventual sale or the value of these items. These items are either just being manufactured or waiting for further operations in queue or a buffer storage.

Optimal production management aims to minimize WIP. It requires space for storage, represents bound capital which won't be available for investment and carries an inherent risk of earlier expiration of the products. A queue heading to a production step shows that the step is rightly buffered for shortage in supplies from preceding steps, but may also show insufficient capacity to process the output from these preceding steps.

Just-in-time (JIT) production concept is used to reduce work in process with respect to a continuous configuration of product.

Fig.1 Fully Assembled HVAC

Just-in-time (JIT) production concept is used to reduce work in process with respect to a continuous configuration of product.

We analyze the current production system and devise a new strategy based on the following factors that affect productivity.

2. Factors affecting productivity

Following are the factors based on which productivity can be discussed and improved.

- *Current distance travelled by a part:*

Under this factor, we calculate the distance travelled by a part that is required for HVAC assembly. The Logistic department purchases the part from the supplier. The supplier location is said to be the starting part. It is then received and stored at the inventory station. Then, it is unpacked, verified for correctness and authenticity and a then undergoes a quality check. After that, it resent to the inventory and stored there until the operating engineer places an order for the part. The movement of semi assembled parts and half-finished parts is also considered.

The entire distance is calculated and categorized as **VA (Value Added) and NVA (Non-Value Added).**

- *Material Handling Frequency*

The material required for assembly is handled frequently at many stations not only in the assembly line but also at the other stages that affect productivity. For ex. Parts and sub-parts pass through various stations before the assembly line for various reasons. During setup changes, the parts need to be repacked and resent to the Inventory stations. This doubles the material handling. Moreover, the production based on demand, the parts also need to be counted before they can be repacked and sent

- *Space Occupied by Assembly Line:*

The total area available on the shop floor is limited and needs to be used to its fullest for the high efficiency. Here, we calculate the area required/occupied by the assembly line on the shop floor. The next step is to estimate the number of units that will be produced from the line. This will give us a fair idea as to what will be the cost of the assembly line in terms of the space occupied, parts produced and monetary basis. For ex. The assembly line for Volkswagen occupies 5000 sq. ft and it produces 10,00,000 HVAC units per year. Meanwhile, assembly line for MAN occupies 7750 sq. ft and produces 10,000 HVAC units per year. Thus, the Volkswagen line is more profitable than the MAN line.

- *Cost of Inventory and Inventory Space:*

A product in the inventory section is undesirable for any organization, as it occupies not only monetary space but also increase the storage requirements of the organization.

Although the 2 Bin System is regarded as the most efficient, in this case, the production being slow and cost of parts being high, having an extra bin on the assembly line is increasing inventory costs and occupying unnecessary space.

- *Ergonomics of the Setup*

The ergonomics of any setup is the most important factor for any assembly line. It determines the comfort level and ease of operations for the operating engineer. If the interface of the assembly line is designed to be operator friendly, the operating engineer will be more comfortable during the assembly process. Thus, the operating engineer can work more efficiently and give a better output than before. Thus, an ergonomic setup of the assembly line can help to improve productivity.

- *Setup time reduction during Changeovers*

The current manufacturing line is designed to assemble Tata Y1 and 2 variants of VECV i.e LHD & RHD. The tools, parts and raw materials required for their production do not have common parts hence while switching over from Y1 to VECV or vice-versa the whole setup needs to be changed. Changing of setup takes approximately 210 minutes. Example-we are manufacturing HVAC'S for Y1, after a two three days of manufacturing we need to switch to VECV. This requires counting of remaining Y1 parts and punching them for exit to inventory, tagging them on SAP system, repacking and transporting back to Inventory, ordering of parts for VECV which requires time to come from the inventory and later change of fixtures available at the line. Presently, Setup Time is the major bottle neck of the production.

3. Proposed changes

3.1 Replacing the traditional 2 Bin system with a Single Bin & Storage Rack.

Two bin is a simple pull system. The parts are provided by two rotating containers. When a bin is unoccupied, it is returned to the supplying process to refill. The second bin supplies parts while the first one is being filled. TWO bin system is advantageous for high production lines but in this case the production rate is too low and also there has to change in setup as the same line accounts for two different HVAC'S.

Our proposal is to eliminate the idea of two bin system. This will help us with more space available at the floor space by redesigning the assembly stations. Utilizing this floor space can be used to create a new storage rack.

Example-If we are manufacturing Y1 HVAC,The material for Y1 are in the main rack which is now a 1bin system, The other rack stores the material for VECH HVAC, when there is a need to switch we switch the material bins from the storage rack and order for a refill for Y1 materials. Following are the benefits

- This change will significantly reduce the part distance travelled as the returning parts will be stored on the assembly line itself.
- Material handling frequency is reduced by approx. 40%
- The Cost of Inventory will be reduced as no unnecessary parts will be stored on the assembly line.
- The Setup Time will be significantly reduced as the need to count, tag and repack the parts during changeovers is eliminated. The material bins can be simply switched from the storage rack. Estimated Setup time in this system is 30 minutes.

3.2 Redesign of Fixtures

Currently the fixtures designed are mounted on a two bolt system. This requires removal of two bolts while replacing, replacing the fixture and again assembling new fixture with two bolts.

Our proposed method is to have an alternate fixture i.e-It will have Y1 fixture on the top and VECV on the bottom side. This will lead to saving of time while changing between two fixtures as we only have to turn it, without putting in the efforts to replace it. It leads to considerable amount of saving in setup time.

The new assembly station design as per the new system will be created to accommodate such a fixture.

3.3 Introduction of a Trolley for Child Parts

The current scenario is that at every station different cabinets are available for small/child parts. Parts even if similar have different cabinets at different station. Our proposal is to keep a centralized trolley for child parts which shall help in saving floor area.

Fig.2 Present setup for child parts

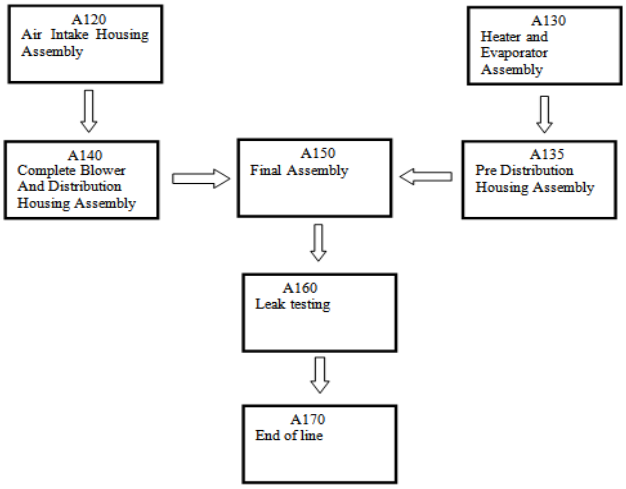
Fig.3 Proposed setup

3.4 Using Material Bins instead of Boxes for Incoming material

Material boxes that come from the inventory contain large number of parts most of which have to be returned during changeover periods. Using material bins will reduce those numbers and ensure that sufficient number of parts will arrive at the assembly line.

3.5 Change in the Layout of the Assembly Line

Proposed Layout



Conclusions

- Replacing Two bin system with single bin system and an extra rack for holding parts at floor space itself rather than inventory will save time
- Change in fixture setup will help reduce setup time.
- Introduction of trolley for child parts will help in better utilization of available rack area.
- Assembly layout on optimization will help in faster assembly of the product.
- At present, changeover of setup takes around 210 minutes
- Application of above proposed changes may reduce the setup time around 50 minutes

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