

A Review on use of Mistake Proof (Poka Yoke) Locating Fixture on Ultra SD Cartridge Assembly Line

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Abstract— Manufacturing defects are the major concern of all manufacturing industries. These defects occur due to poor material quality or lack of skilled labour. This paper focuses upon one such operation that was dependent on the skills of the operator which was deskilled by one of the successful devices in lean production which is used to eliminate waste caused by errors i.e 'mistake-proofing' or 'Poka-yoke'. The use of Poka Yoke in the Ultra SD Cartridge assembly operation eliminated the requirement of skilled operator. This was effectively done by introducing a new locating fixture on the assembly line.

Keywords— Poka Yoke , Deskilling of operations, locating fixture.

I. INTRODUCTION

A "manufacturing defect" is a problem that becomes part of the product when it is made. The two most common causes of manufacturing defects are poor-quality materials and carelessness in putting the product together, or shoddy workmanship. A manufacturing defect is one that could be made less dangerous, or gotten rid of altogether, if the product were made with better-quality materials or was made by a more careful and experienced worker. The manufacturing industries are constantly shifting to new areas in order to obtain cost effective and economic resources. The Experienced workers may not be available at these places and therefore it is very important for any manufacturing industry to reduce its dependence on the skilled labour. This dependence on the skilled labour was very high in lock manufacturing industry and to reduce this dependence a Lean manufacturing tool (Poka Yoke) was used.

In any industry, to reduce the dependence on skilled labour, it is very essential to identify the key areas where the skilled employee plays a key role. After the identification of these defect causing area , the process should be altered in such a way that the work done by the skilled operator is replaced by some sort of machine or device which is an essential part of the process itself and

can be moved wherever required. In this paper we have discussed about a Defect that could have occurred on the Ultra SD Cartridge Assembly Line after its shifting to the new factory location due to lack of Skilled labour.

II. THE PIN FILLING PROCESS OF ULTRA SD CARTRIDGE ASSEMBLY

The Ultra SD Cartridge is a Level 2 security Product, which is commonly used in safe deposit locks. The Ultra Sd Cartridge was made by assembling 4 products

1. Ultra SD Cylinder + Housing subassembly
2. (Note: Ultra SD Cylinder + housing is written as CH for convenience)
3. 2. The operating pin
4. 3. The driver pin
5. 4. The Spring

The ultra SD cylinder + housing are prepared in three stages. The CH consists of three rows of drilled holes and at each stage a specific row is pin filled according to the provided combination of pin.

It is very important to select the row at each stage, because a minute mistake in this could lead to malfunctioning of the entire lock.

The process of Ultra SD Cartridge Assembly is explained below.

The Pin filling process

1. The operator picks up an Ultra SD Cylinder + Housing from the tray
2. The operator inspects the lock manually and aligns the lock CH with respect to the drilled holes
3. The operator puts the lock CH on the the fixture with the row to be filled on the topmost surface
4. The operator fills 4 operating pins from the pin tray within the CH by observing the combinations on the HMI Screen
5. The operator fills 4 driving pin pins from the pin tray within the CH

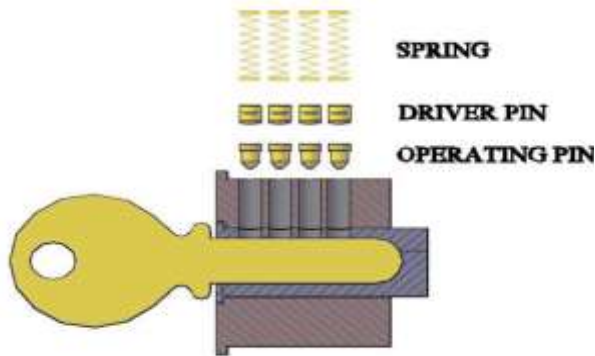


Fig.2.1: Assembled Ultra Sd Cartridge

III. THE PROBLEM

The above highlighted operation is the step where the skills of the operator were required. The Ultra SD Cylinder + Housing Subassembly had a reference hole on the collar .which was observable from in the front view.

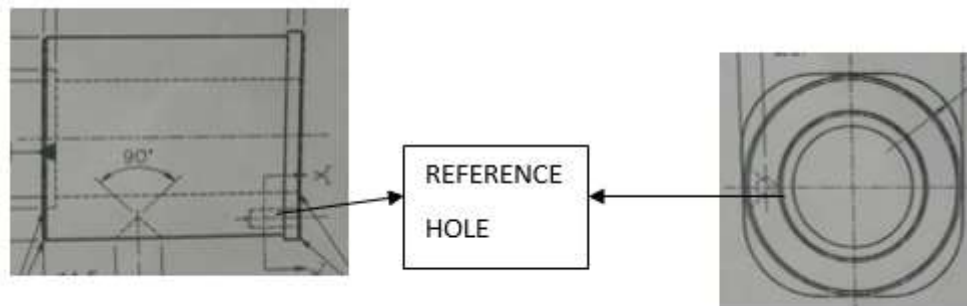


Fig.3.1: Front View of CH

This reference hole had a specific position for each row when it was on the topmost surface .The row which was on the topmost surface was pin filled by the operator. Therefore to get the desired row on the top most surface it was very essential to locate the position of this reference hole. This was the area where the skilled operation was required .Depending upon the problem various all the devices were observed and the following solution was implemented.

Functions of a Fixture:

1. To increase the production.
2. To assure the high accuracy of the parts.
3. To provide for interchangeability.
4. To enables heavy and complex shaped parts to be machined by holding rigidly to a machine.
5. To control quality control expenses.
6. Less skilled labour.
7. Saving labour.
8. There use partially automates the machine tool.
9. Improve the safety at work, thereby lowering the rate of accidents

Function of a Locator:

1. To Locate the Part
2. To support the Part
3. To hold the part

The problem was then eliminated by combining the functions of a fixture and locator. A new mistake proof solution was obtained using the poka Yoke method.

IV. POKE YOKE

Poka-yoke is a Japanese term that means "fail-safing" or "mistake-proofing". A poka-yoke is any mechanism in a lean manufacturing process that helps an equipment operator avoid (yokeru) mistakes (poka). Its purpose is to eliminate product defects by preventing, correcting, or drawing attention to human errors as they occur. The concept was formalised, and the term adopted, by Shigeo Shingo as part of the Toyota Production System. It was originally described as baka-yoke, but as this means "fool-proofing" (or "idiotproofing") the name was changed to the milder poka-yoke. Shigeo Shingo recognized three types of poka-yoke for detecting and preventing errors in a mass production system. The contact method identifies product defects by testing the product's shape, size, color, or other physical attributes. The fixed-value (or constant number) method alerts the operator if a certain number of movements are not made. The motionstep (or sequence) method determines whether the prescribed steps of the process have been followed. Either the operator is alerted when a mistake is about to be made, or the poka-yoke device actually prevents the mistake from being made. In Shingo's lexicon, the former implementation would be called a warning poka-yoke,

while the latter would be referred to as a control poka-yoke. Shingo argued that errors are inevitable in any manufacturing process, but that if appropriate poka-yokes are implemented, then mistakes can be caught quickly and prevented from resulting in defects. By eliminating defects at the source, the cost of mistakes within a company is reduced.

When & Where Poka Yoke is used.

Poka-yoke can be used wherever something can go wrong or an error can be made. It is a technique, a tool that can be applied to any type of process be it in manufacturing or the service industry. Errors are of many types;

1 Processing error: Process operation missed or not performed per the standard operating procedure.

2 Setup error: Using the wrong tooling or setting machine adjustments incorrectly.

3 Missing part: Not all parts included in the assembly, welding, or other processes.

4 Improper part/item: Wrong part used in the process.

5 Operations error: Carrying out an operation incorrectly; having the incorrect version of the specification.

6 Measurement error: Errors in machine adjustment, test measurement or dimensions of a part coming in from a supplier.

How to use it?

Step by step process in applying poka-yoke:

- Identify the operation or process - based on a pareto.
- Analyze the 5-whys and understand the ways a process can fail.
- Decide the right poka-yoke approach, such as using a shut out type (preventing an error being made), or an attention type (highlighting that an error has been made) poka-yoke take a more comprehensive approach instead of merely thinking of Poka-yokes as limit switches, or automatic shutoffs a poka-yoke can be electrical, mechanical, procedural, visual, human or any other form that prevents incorrect execution of a process step
- Determine whether a contact - use of shape, size or other physical attributes for detection, constant number – error triggered if a certain number of actions are not made sequence method - use of a checklist to ensure completing all process steps is appropriate
- Trial the method and see if it works
- Train the operator, review performance and measure success.

V. APPLICATION OF POKA YOKE

The area where the defect could occur, if skilled operator is not used was anticipated and induction of a new fixture along with the a locator was chosen as a feasible solution. The fixture that was used earlier was only meant to hold the CH in position while the pin filling operation was being performed. It was important to locate the CH on the fixture itself so ,that it could be an integral part of the process .



Fig.5.1: The Old Fixture

The new fixture was made up of mild steel and it consisted of an additional backplate that could locate the CH .The backplate consisted of one cylindrical projection that used to locate the reference hole and a rectangular projection that used to locate the cam slot which was present on the CH .The backplate also consisted a guideway that facilitated the proper placement of CH on the Fixture.

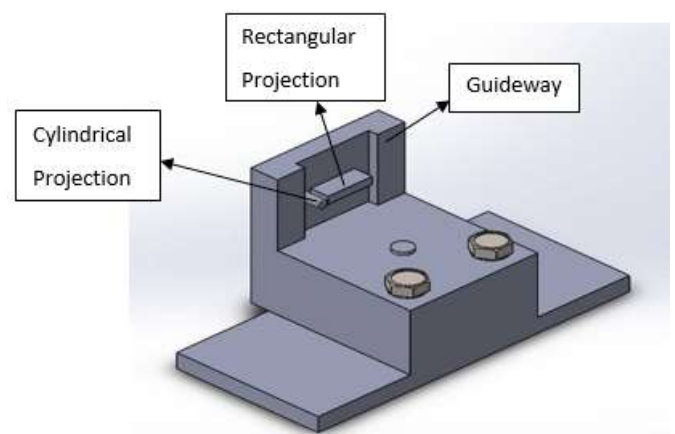


Fig.5.2: The New Fixture

The back plate was made as per the dimension of CH with a tolerance of 0.02mm.The proper placement of the cylinder on the new fixture assured the row to be pin filled to come on the top surface, if a random row was selected then the CH would be placed properly on the fixture.



Fig. 5.3: Properly Placed CH



Fig.5.4: Improperly Placed

The properly placed CH did not have a Gap between the collar of CH and the backplate, while the one which was not placed properly had a gap.

VI. CONCLUSION

The introduction of the new fixture on assembly line completely eliminated the possibility of the operator pin filling a wrong row. The guide ways on the new fixture facilitated a firm placement on it .The CH did not distort from its position during the pin filling operation.

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