# PROCEEDINGS

## 4th International Conference on Technical and Vocational Education and Training (TVET)

**Theme:**
**Technical and Vocational Education and Training for Sustainable Societies**

**Padang, November 9-11, 2017**
**at Hospitality Center**
**Universitas Negeri Padang**

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### Theme: Technical and Vocational Education and Training for Sustainable Societies

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# FOREWORD

Welcome for all respected scholars, researchers, post graduate studentsand especially Keynote Speakers to the 4 ICTVET. The theme of the conference focus on Technical and Vocational Education and Training for sustainable societies and consist of six subthemes. i.e Development of learning model on TVET, Workplace Learning and entrepreneurship, Innovationon applied engineering and information technology, Management and Leadership on TVET, Vocational and Technical Teaachers education, and Assessment and Evaluation on TVET.

Sustainable society shoul be followed by the improvement of various factors that have impacts to the quality of vocational and technical education and training, particularly to overcome the competitiveness of the world business. As we have already known the rapid change of technology as well as the change of demography, having a great effects to the life of peoples in this world, The competitiveness need a collaborativeness to survive the life of millions peoples who lost their jobs. Young peoples as aproductive generation have to be creative and innovative to face the competitiveness. So this prociding contents consist of various findings of research in the field of vocational and technical education as well as applied technology and mainly based on the subthemes of the conference.

Finally, we would like to thank a million for all participants of this conference and all parties who support the success of this conference. Hopefully the seminars and scientific work of this seminar can be a reference material for basic education and elementary school teacher education in Indonesia.

Padang, July 2, 2018

Tim Editor

**CONTENT PROSIDING ICTVET 2017 REPOSITORY UNP**

# MODIFICATION OF INPUT PUSHER ASSEMBLY OF LASER MARKING MACHINE

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**ABSTRACT:** Laser marking process is one of the process steps in Integrated Circuit (IC) assembly manufacturing. This process is to mark the IC unit with the device information, assembly information and product brand. One type of lead frame used for IC assembly is an open-end lead frame which caused the individual lead on end unit prone to damage due to hard mechanical contact. A laser mark process, the lead frame will be pushed into the laser chamber by using a solid input pusher. The existing design of input pusher will push the lead by making contact with the edge of the lead frame. Production section keeps observing the damage lead problem occurred when process the open end lead frame. Damage lead was 54% of the defect occurred at laser mark process. This problem causing low yield and high rework. The team has been established to analyze the problem and found the solution. Through investigation and analysis, the team found the root cause of the problem and takes the appropriate corrective action. Design modification of input pusher from the previous design which was the solid type to be U-type significantly reduces the damage lead at laser mark process. Initial observation showed that the new design able to reduce 98% of damage lead.

*Keywords: Design modification, Laser Machine, Damage Lead*

## Introduction

Integrated Circuit (IC) is a vital electronic component that is used widely in electronic application. This component is used in a consumer product, telecommunication, computer and automotive industry. Global competition and market-driven have motivated the multinational company which produces IC to subcontract the IC assembly manufacturing to the Asian country. One of the countries selected by the industry to be the offshore site of assembly manufacture is Batam island of Indonesia.

There is one IC assembly manufacture located in Batamindo Industrial Park Muka Kuning, Batam. This is one of top 10 IC assembly subcontractors in the world. In this factory, ICs are assembled starting from wafer chip up to the final IC component. The process steps to assemble the IC is started from wafer saw process. At this process, the wafer will be sawn to be single chip called as die. The single die then attached to a copper lead frame using conductive epoxy glue. To strengthen the bonding, the workpiece will be cured at 125$^{o}$C. The next process is to connect the die to the lead frame using gold wire by ultrasonic welding. This process is called as wire bonding. All these processes are classified as front-line production. Wire bonded die then goes to molding process where the workpiece will be covered by using epoxy mold compound plastic that categorized as thermoset plastic. The process then continued by solder plating process where the copper lead frame will be coated with tin (Sn).For device identification, the IC package will be marked using laser process. The information written on the package contains device name, manufacturing code, and product brand. After completion of the laser marking process, the workpiece will be trimmed and formed to be single IC unit, then the final IC component is ready to ship to the customer, the owner of the product.

In this paper, it will be elaborated the process of laser marking. At this process, workpiece will be loaded into the input track of the machine then the workpiece will be pushed into the laser chamber using a pusher assembly called as input pusher. Inside the laser chamber, a laser system will mark the IC package. Then finally, the marked workpiece will be pushed out of the chamber and unloaded to the carrier bag. Production section observing quality issue of the product such as marking defect, package defect, and lead defect. Production data showed that the lead defect contributed 54% of total defects. This quality issue is concentrated on open end lead frame type.

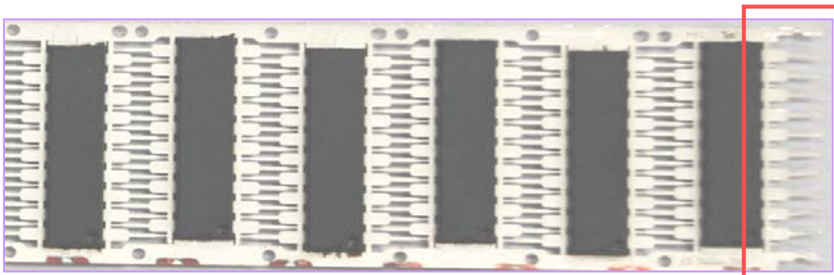



Fig 1. Open end lead frame

**Methodology for Improvement**

To address the quality problem, need to establish a cross-functional team. The team members are from a multidiscipline function in the organization such as process engineering, equipment engineering, quality assurance, production.

Table 1. Steps for improvement

| Activities | Method |
|---|---|
| 1. Problem identification | Production data analysis.<br>Process observation. |
| 2. Problem analysis | Brainstorming.<br>Team discussion |
| 3. Potential cause verification | Simulation. |
| 4. Solution development | Brainstorming, discussion.<br>Benchmarking, Simulation. |
| 5. Solution effectiveness | Simulation. |
| 6. Solutions implementation | Action |

**Problem identification**

Data for the quality problem at laser marking process collected for last one month indicated that damaged lead is top defect. Further observation and analysis on the defect mapping showed that 54% of damaged lead occurred at pusher section of laser marking machine.

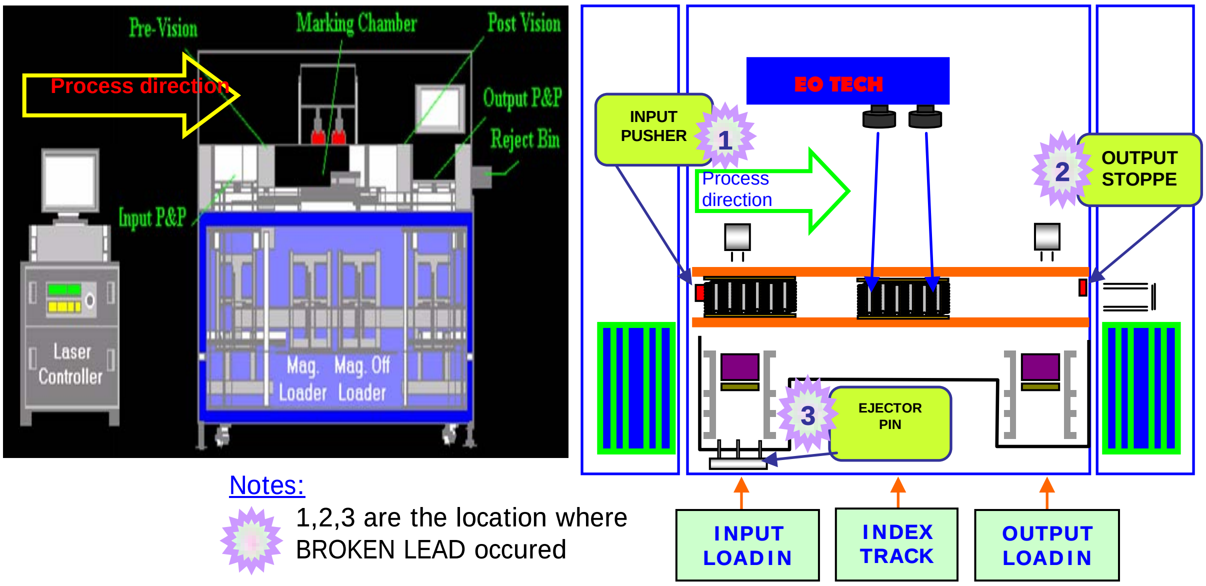



Fig 2. Schematic of laser marking process

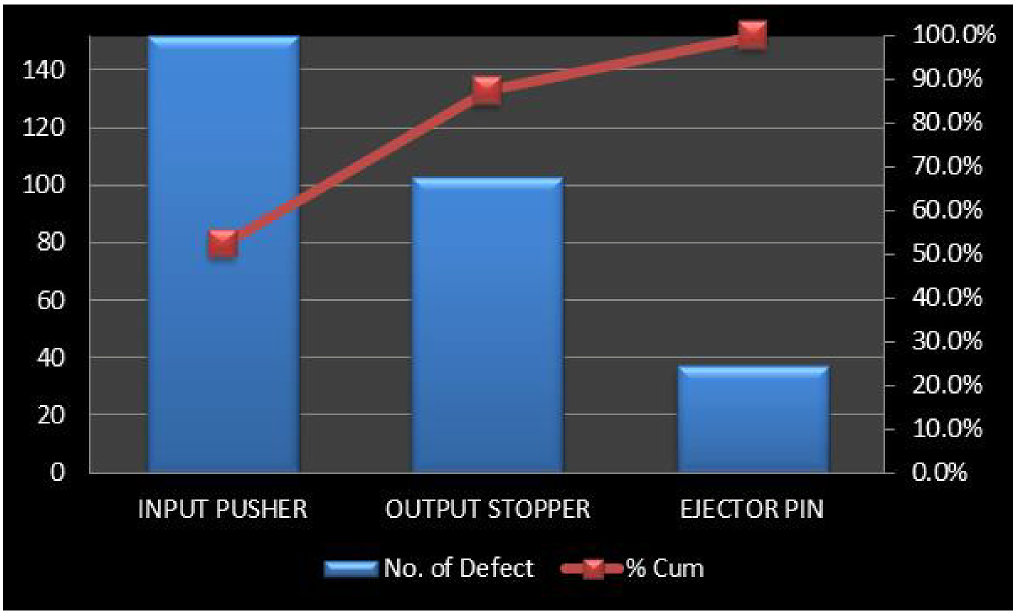



Fig3. Pareto of damage lead occurrence in the laser mark machine

**Analysis the problem**

Referring to Pareto of the damage lead (fig. 3), the team did further analysis on input pusher assembly. Fishbone diagram method is used to analyze the potential cause of the problem that will be verified to find the root cause of the problem.

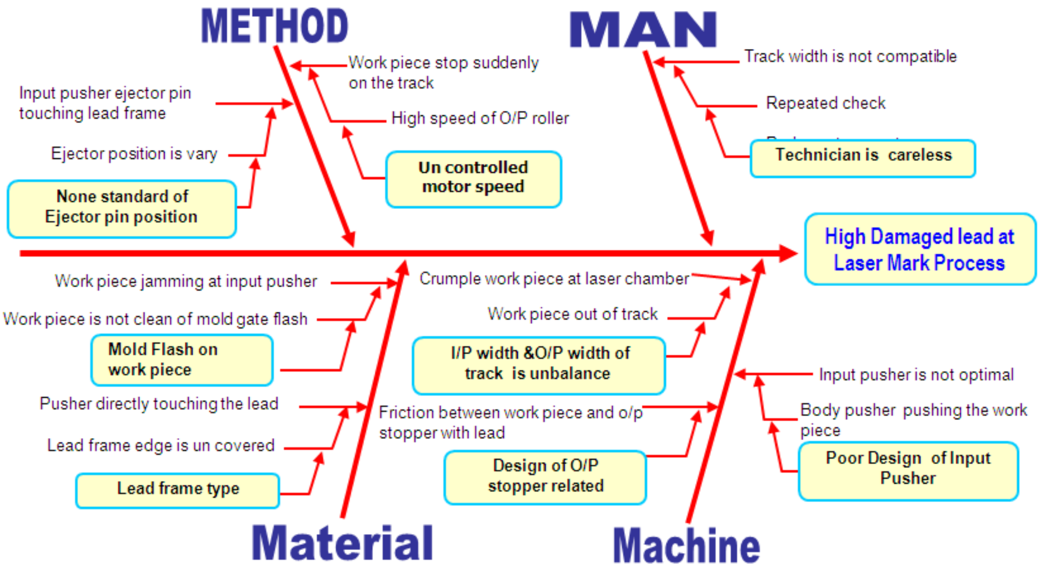



Fig 4. Fishbone diagram

Verification of the potential causes derived from fishbone diagram revealed that few potential causes are not confirmed.

Table 2. Potential causes verification

| NO | POTENTIAL CAUSE | Verified by | Result |
|---|---|---|---|
| 1 | Technicians are careless when checking the track width. | Adi | Not confirmed |
| 2 | Poor design Input Pusher | Tarno | Confirmed |
| 3 | Unbalanced width of i/p & o/p track | Sugi | Not confirmed |
| 4 | Poor design of output stopper | Adi | Confirmed |
| 5 | Mold flash on the workpiece | Tarno | Not confirmed |
| 6 | Type of lead frame which is open lead frame | Sugi | Confirmed |
| 7 | None standard position of Ejector Pin | Sugi | Confirmed |
| 8 | Uncontrolled output roller motor | Tarno | Not confirmed |

The original design of input pusher directly touches the lead frame edge. If the workpiece having abnormal mold gate end flash as poor quality of molding process, then the workpiece will abnormally bend that called side bent. This condition can disturb the smoothness of workpiece sliding on the track such as high frictions. To keep the workpiece moving, the input pusher will push the workpiece with higher forces. Due to the input pusher touching the lead with higher force, therefore the lead contacted with pusher will damage.

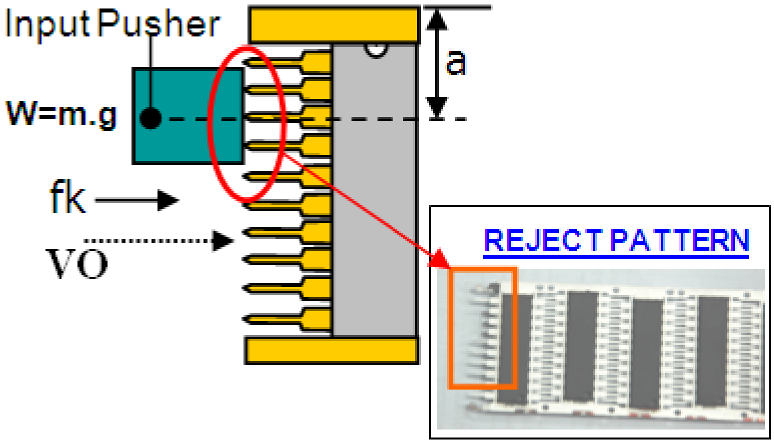



Fig. 5 Input pusher directly contact with lead

Output stopper is a machine part that has a function to stop the movement of the workpiece on the track. If workpiece moves to fast on the track, it will hit the stopper hardly and this prone to cause damage lead.

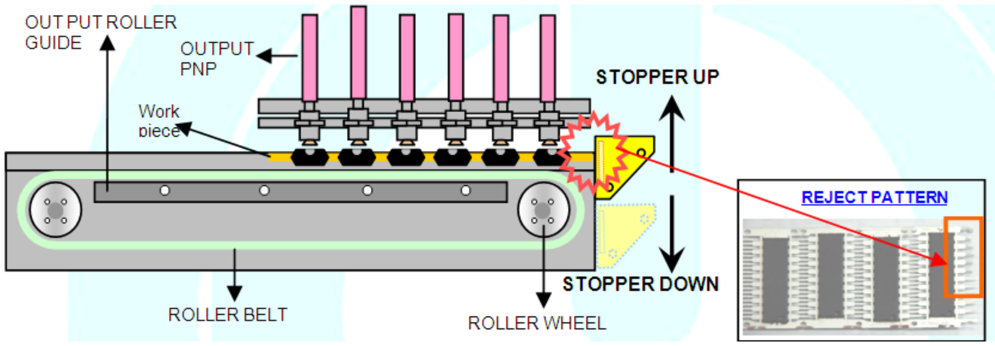



Fig 6. Workpiece hit the stopper hardly

The stopper mechanism moving up and down. The original design of output stopper having a flat surface facing the lead. This design provides the high possibility of the lead to be damaged when there is hard contact.

**Corrective action**

Four out of eight potential causes were verified and confirmed causing the problem. The team conducts brainstorming to develop corrective actions.

1. None standard position of ejector pin is confirmed as a potential cause. To address this potential causes, the standard position of ejector pin is defined and classified as a critical item to check when doing the machine set up. The working document is revised to document the standard position. All technicians are required to use the word document as a guideline when setting up the machine.
2. Type of lead frame with an open end is confirmed. However, modification of lead frame requires high cost since vendor involvement is required. The team considered this potential cause as the last potential cause to address.
3. Team focus on the poor design of input pusher and output pusher which is confirmed

as potential causes. Then, the corrective actions to improve the design are considered.

**Methodology in improving the design of input pusher and output pusher:**

Upon the confirmation of poor design of input pusher and output pusher, the team develops ideas for modification of the existing design.

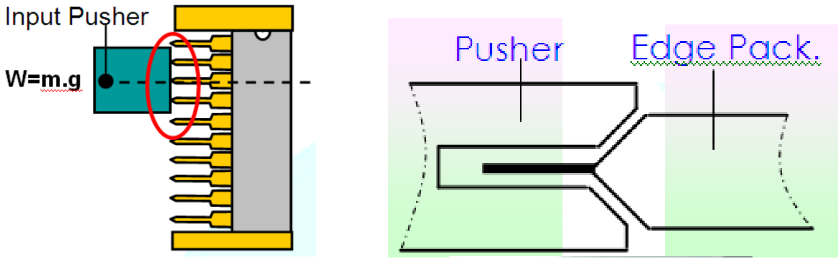
1. Modification of input pusher.

There are 2 alternatives to design modification for input pusher;

Table 2. An alternative design for improvement of input pusher.

| Alternative modification | Correlation to the potential cause | Effectiveness verification |
|---|---|---|
| **ALTERNATIVE 1** | | |
| Redesign input pusher to be U-shape | With this design, the pusher will not directly contact with the lead edge. | Computer simulation indicates this design is effective |
| **ALTERNATIVE 2** | | |
| Enlarge the cross-section of input pusher. | With this solution, then pusher is wider enough to push more leads that resulting in less force transmitted the lead. | This modification still has direct contact between the pusher and the leads and prone to damage the lead in case the workpiece jamming. |

The first alternative is selected as corrective action for input pusher since the simulation indicates its effective.




a). Original design b). Modified design

Fig 7. Difference between original design and modified design

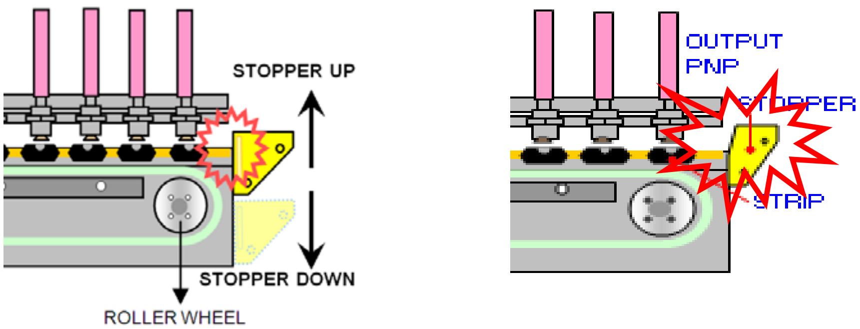
2. Modification of output pusher.

Two 2 alternatives of design modification for output pusher were developed.

Table 3. An alternative design for output stopper.

| Alternative modification | Correlation to the potential cause | Effectiveness verification |
|---|---|---|
| **ALTERNATIVE 1** | | |
| Change the flat surface of the stopper to be chamfer and make the stopper wider. | Wider cross-section of the stopper and chamber design will reduce the possibility of lead damage when there is a hard collision between workpiece and stopper. | Computer simulation shows that the possibility of damage lead can be reduced. |
| **ALTERNATIVE 2** | | |
| Change stopper material from stainless steel to be Teflon | Teflon will reduce the impact when collision happen. | If the stopper design still the same with the existing design, the change of material will not significantly reduce the damage lead. |

Upon verification, both alternative solution were combined. Teflon will be used to replace the stainless steel and stopper surface will be chamfered.




a) Original design b) Modified design

Fig 8. Difference between the original design and modified design of output stopper.

**Solution effectiveness**

Upon verification of the effectiveness of design modification of input pusher and output stopper, production data has been collected. Comparison between previous data (before design modification) and new data (after design modification) will be used to justify the effectiveness of the solution.

Further data collection is required to confirm the effectiveness of design modification. The previous data is monthly average of damage lead defect while the new data were collected for one week period only. However, the available data may be used for initial review of the effectiveness. Data showed that the damage leads are reduced significantly.

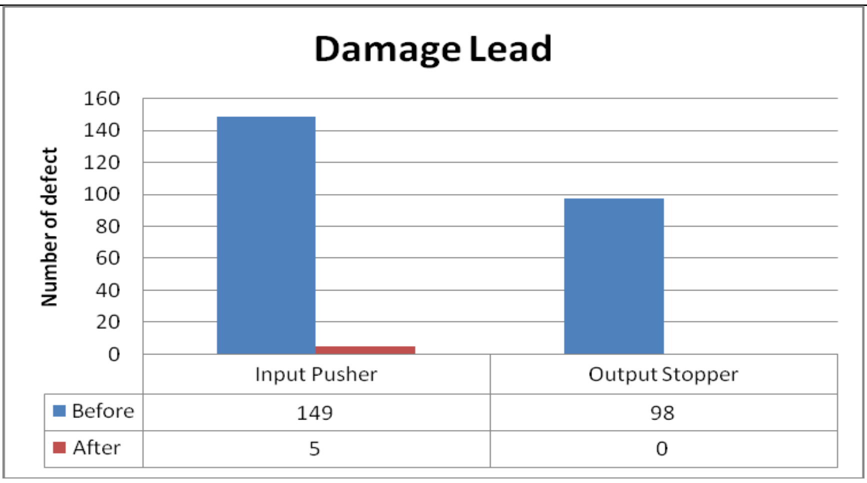



Fig 9. Comparison before and after

**Conclusion**

Modification of input pusher and output stopper of laser marking machine has been taken as a solution to reduce damage lead problem during laser marking of Integrated Circuit assembly manufacturing.

In this case, modification of input pusher and output stopper has reduced 98% of damage lead.

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