# Analysis Of The Cause Of Not Stick Wedge On Chip On Board

## Final Project


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## I. Statement of Authenticity of Final Project

I, the undersigned, declare that the contents of part or all of my Final Project entitled: "Analysis Of The Cause Of Not Stick Wedge On Chip On Board" **is my own work, completed without the use of unauthorized materials, and is not the work of others that I recognize as my own.** All references quoted or referred to have been written in full in the bibliography. If it turns out that my statement is not true, I am willing to accept sanctions according to applicable regulations.

Batam, 28 June 2024

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# I. APPROVAL

**The Final Project was prepared to fulfill one of the requirements to obtain the degree of Bachelor of Applied Engineering (S.Tr.T)/Associate Degree in Engineering (AMd.T.)**
**in**
**Politeknik Negeri Batam**

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# Analysis of the Cause of not Stick Wedge on Chip on Board

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***Abstract*- Wedge Bond is one of the bonding methods in the wire bond process. Wedge that does not stick to the leadframe is one of the defects in the Wire Bond process. One of the impacts of this defect is that the chip becomes disconnected from the leadframe, so that RFID products cannot be used because of this defect. The purpose of this research is to find the cause of the defect, because this defect occurs quite often when doing the Wire Bonding process on COB RFID. The method in this research the author uses Fishbone Diagram. Fishbone Diagram consists of several factors, namely Man, Machine, Material, Method, Measurement, and Environment. By using Fishbone Diagram, the author can analyze some of these factors. The author tries to do BrainStorming with several students/parties who have done the Wire Bonding process. After doing BrainStorming, the author will get several possible causes of defects, then verify the possible causes that have been found. The expected result of this research is that the author can find the main cause of the defect. So that in the future a solution can be found so that the defect can be overcome or even avoided. In this research, the cause of the problem in this defect is the Wedge Parameter which is less accurate, so the author adjusts the previous parameter.**

**Keyword: Wedge Bond, COB RFID, Fishbone Diagram**

## I. INTRODUCTION

Making things lighter, smaller, thinner, shorter, and faster, while also making them more amiable, useful, strong, dependable, and affordable, is the main trend in the electronics business right now. The introduction of more user-friendly devices with a larger range of functionalities will stimulate expansion in the market as the trend toward small and compact items continues. Electronic packaging and assembly technology, particularly wire bonding, tape automated bonding, and flip bare Chip on Board (COB) technology, is one of the major technologies that is assisting in the achievement of these product design goals. [1]

The welding process known as "wire bonding" is carried out by jointly deforming the wire and the substrate to create an alloy out of the two materials. via reducing flow stress and providing an easy-to-slip mechanism for dislocation movement, ultrasonic energy improves the process (deformations occurs via the movement of dislocation). During deformation, the materials flow together to produce intermetallic compounds, which proliferate by diffusion. Wedge bonding can provide a full strength weld with less deformation than ball bonding since it deforms the wire without causing it to first form a ball.[2]

The most common technique for connecting an integrated circuit (IC) to a substrate electrically is wire-bonding. Over 4 trillion wire bonds are created every year.[3] Ultrasonic wedge-bonding is a different wire-bonding technology that has numerous uses. The most common method employed now is thermosonic ball-bonding of gold wire onto aluminum metallization.[3]

When using aluminum wire, ultrasonic wedge-bonding typically takes place at room temperature and forms the first and second bonds simultaneously with a normal bond force and ultrasonic energy.[3] Ultrasonic wedge bonding is a favored technique for connecting power devices because it forms the first and second connections at room temperature by concurrently using ultrasonic energy and a normal bond force[4]. Chip-on-Board (COB) technolgy involves mounting bare dies directly on substrate without the need for the component's package. Eliminating the component package reduces the required substrate area and assembly weight and removes one entire level of interconnects. COB technolgy also reduces the thermal resistance and the number of interconnects between an active die and the substrate (i.e., the package pins), which can potentially improve the overall circuit speed and the reliability of the design.[5]

In a Chip-on-Board (COB) assembly, a silicon die is wirebonded directly to a substrate material (no packaging is required). The assembly is then coated with a glob-top epoxy resin and cured to provide a protective seal.[6] During assembly and stress testing, a routine of visual inspection, electrical measurements, and acoustic microscopy analysis was performed at regular intervals to monitor the performance of the COB devices.[6]

Kaoru Ishikawa, one of the pioneers of modern management, popularized Ishikawa diagrams in the 1960s by introducing quality management procedures in the Kawasaki shipyards. Its form, which resembles the side view of a fish skeleton, has earned it the nickname "Fishbone Diagram."[8] When Ishikawa diagrams were first developed, they were primarily utilized in the engineering sector to look into the underlying causes of product failures or defects that quality assurance staff had found.[9]

The fishbone diagram provides comprehensive details of all plausible reasons to identify the issue's underlying cause. This technique's primary benefit is having a clear grasp of the issue, its root causes, and the extent to which it affects the output in the end[7]. The method focuses on considering every potential source of an issue by using a diagram-based approach. This aids in doing a comprehensive situational analysis[7].

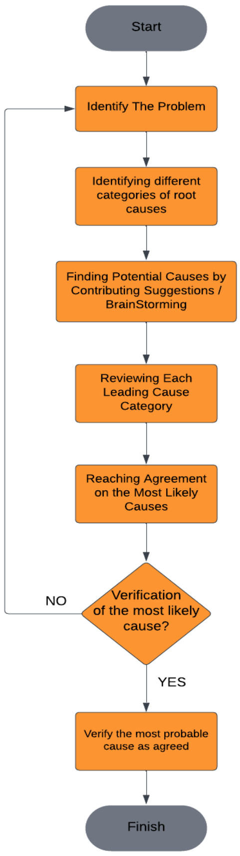
In October 2023, one of the PBL Polibatam teams found a defect in the Wire Bonding process for Chip on Board (COB). The defect that occurred was Wedge Not Stick. This means that the wire does not stick to the surface of the chip. The bonding method used in this case is Wedge-Bump.

To find out the cause of why this defect can occur, the author took the initiative to find the main cause of the defect. The method used by the author in this case is to use the Fishbone Diagram method. The author will conduct BrainStorming with students/parties who have done the process.

## II Method

The research method used to find this defect is using Fishbone diagram and then testing.

### *A. Flowchart for data collection*




Picture 1 . Flowchart of Data Collection

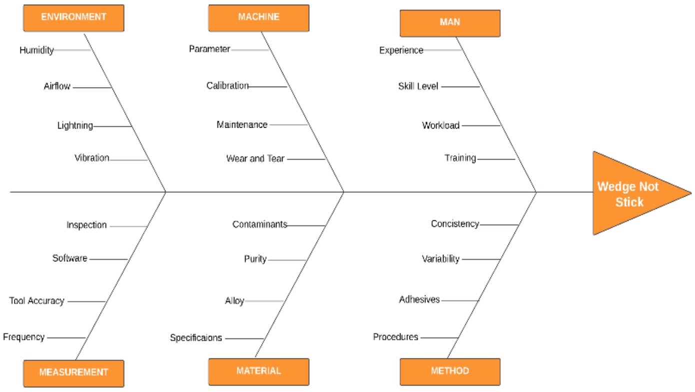
The picture above (Picture 1) is a flowchart of data collection in this study.

The author starts by identifying the problem, namely the author identifies the problem to be discussed, for the problem to be discussed in accordance with the research title, namely Wedge Not Stick.

After identifying the problem, the author determines the main cause category of the problem. As in Fishbone Diagram in general, the author uses several categories/factors such as Man, Machine, Method, Material, Measurement, and Environment. Then, the author conducted BrainStorming with several students/practitioners/labors who have done the process to collect possible causes of defects.

After obtaining various possible causes of defects, all possibilities will be reviewed to ascertain which cause is the most probable/reasonable for the occurrence of defects. And then, an agreement will be made on the most likely cause.

### *B. Brainstorming about possible causes of defects*




Picture 2. Fishbone Diagram

The picture above is a Fishbone Diagram, where the picture is the result of discussions with those who are experienced in this field. There are several categories in the fishbone diagram, including Man, Machine, Material, Method, Measurement and Environment. Which each category has a possible cause of the problem.

The following is an explanation / description of the possibility:

1. Man :
   - Skill Level: The skill level of the operator.
   - Experience: Operator experience.
   - Workload: The workload faced by the operator.
   - Training: Training received by the operator.

2. Method :
   - Consistency: Consistency in the application of methods.
   - Variability: Variability in the method.
   - Adhesives: Proper use of adhesives.
   - Procedures: Standard operating procedures.

3. Machine :
   - Parameters: Parameters that are not quite right
   - Calibration: Proper machine calibration.
   - Maintenance: Routine machine maintenance.
   - Wear and Tear: Wear and tear conditions on the machine.

4. Material :
   - Contaminants: The presence of contaminants in the material.
   - Purity: The purity of the material.
   - Alloy: The type and quality of alloy used.
   - Specifications: Specifications of the material used.

4. Environment :
- Humidity: Humidity in the work environment.
- Airflow: Airflow in the work area.
- Lighting: Lighting in the work area.
- Vibration: Vibration in the work area.

5. Measurement :
- Inspection: The inspection process performed.
- Software: The software used for the measurement.
- Tool Accuracy: Accuracy of the measuring tool.
- Frequency: Measurement frequency.

After getting several possibilities, the next step is to conclude one possible cause in each category.

TABEL I
Selecting possible causes of the problem.

| **Category of Causes** | **Most likely cause of the problem** |
|---|---|
| Man | Experience |
| Method | Procedure |
| Machine | Parameter |
| Material | Specifications |
| Environment | Vibration |
| Measurement | Inspection |

The table above (Tabel I) is the result of selecting possible causes of the problem. Which will take one of the most likely problems.

And after a long discussion, the possible cause taken is in the Machine category, where the temporary suspicion is due to Parameters. Because this case is located on Wedge Bond, the Parameter in question is the Wedge Bond Parameter

### C. *Parameter Reference*

TABEL II
Wedge Parameter

| Selected Bond Type | Wedge Bond |
|---|---|
| Wedge Impact Force | 350 nM |
| Wedge Bond Force | 150 nM |
| Wedge Bond Time | 28.1 ms |
| Wedge Ultrasonic Power | 25.01 % |

The table above is the wedge parameters used during the WireBond process. These parameters are obtained from students who do the WireBond process and what they use. Later these parameters will be changed and adjusted until the wedge sticks perfectly to the Bond Pad surface.

Parameter value changes are focused on Wedge Impact Force, Wedge Bond Force, Wedge Bond Time, Wedge Ultrasonic Power

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## II. RESULT AND DISCUSSION

The following are the adjusted parameters and the results of the Wedge attachment process on the BondPad.

### A. *Changed Parameters*

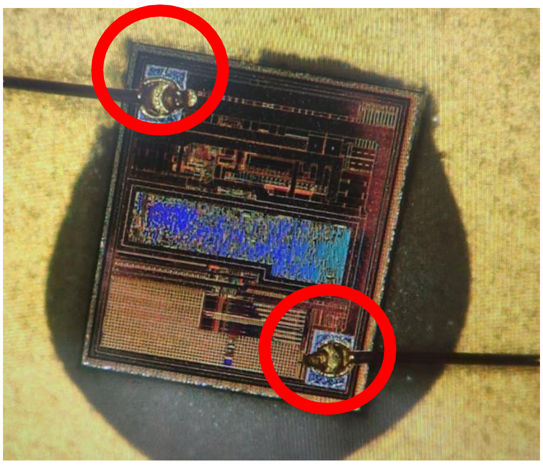
TABEL III
Wedge Parameter

| Selected Bond Type | Wedge Bond |
|---|---|
| Wedge Impact Force | 300 nM |
| Wedge Bond Force | 100 nM |
| Wedge Bond Time | 21.8 ms |
| Wedge Ultrasonic Power | 25.01 % |

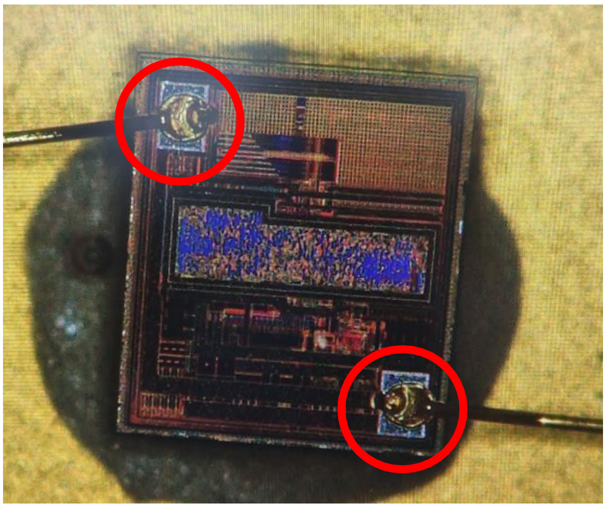
The table above (Table III) is the adjusted wedge parameters. There are several parameters that have been changed, such as Wedge Impact Force and Wedge Bond Force.

The Wedge Impact Force was changed from 350 nM to 300 nM. For Wedge Bond Force, the previous 150 nM was changed to 100 nM.

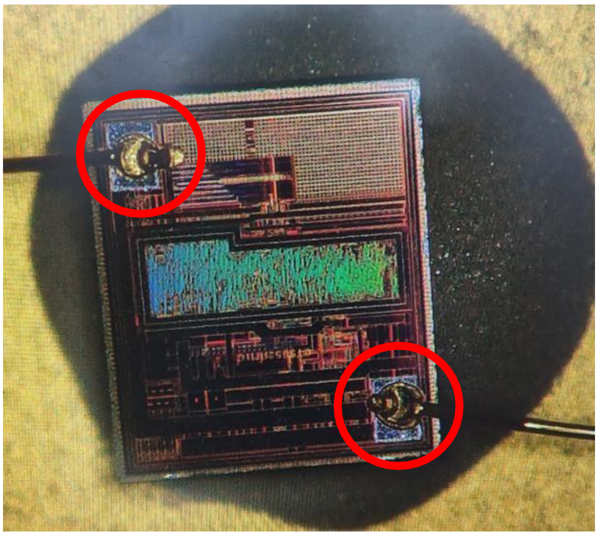
### B. *Process Result*



Picture 3. Result Wirebond by following the parameters in Table III



Picture 4. Result Wirebond by following the parameters in Table III



Picture 5. Result Wirebond by following the parameters in Table III

The images above (Picture 3,4 and 5) are the results of the wire installation process with the Wedge Bond method in the Bondpad area. The parameters used are the parameters in Table III. Which where the parameters have been adjusted from the previous parameters.

In each picture (Picture 3, 4, and 5), there is a red circle, which indicates that it is the result of Wedge Bond using the adjusted parameters.

## III. Conclusion.

The conclusion of the research is that the cause of the defective wedge not sticking is due to parameter errors in the wedge impact force and wedge bond force. However, after these parameters were changed to the default parameters on the machine, the wedge finally stuck again after testing. But it does not rule out the possibility that other causes could be the main cause of this defect as well.

However, in this research, the Wedge Parameter was the cause of the Wedge Not Stick defect.

One of the characteristics of Wedge Bond is said to be good or good result is showing a smooth bonding surface and free of cracks[10]. Judging from Figures 3, 4 and 5, the results of the wedge bond using the adjusted parameters, there are no cracks in the Bondpad area which is late in sticking with the wire.

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