

Proactive Verification of Strip Y-Index to Mitigate Gross Misaligned Cut due to Mismatched Unit Pitching

ABSTRACT

Shopfloor practices that when the first cut line was aligned with the hairline, actual blade cut, and saw street of the strip, the succeeding cut lines will automatically follow with the same alignment. Considering lots of factors that affect the strip it is always recommended to verify the sub indexing response by jogging on succeeding cut lines to project if the hairline will still be aligned with the saw street as cutting goes on. Unfortunately, sub index verification was usually skipped, only trust the first cut alignment as reference and end up risking the units for possible misalignment. With the mentioned scenario which has been encountered from different semiconductor assembly plants, it was best to verify the Y-indexing of the strip on top of verification on the first cut line alignment. The entrapment of wrong workpiece or wrong program will be fast, and units can be prevented from being misaligned cut. Operators will be helped to run the machine with less assistance as unit pitching were already verified and corrected as early as the first cut line.

Keywords: Alignment; singulation process; sub-index checking; unit pitch; Y-index.

1. INTRODUCTION

Singulation process efficiency relates to the correct dimensions of the individual units produced after sawing. In order to produce good units, alignment of blade cut to every saw street of the strip was important. Upon processing of a strip for singulation, the first saw street between the strip remnants and first row of good units will be cut. This first blade cut through will be shown next by the machine for verification of actual blade cut to the saw street of the strip and with the machine hairline. Hairline of the machine is the alignment that indicates where the blade will saw through. Personnel can adjust and correct the alignment if otherwise. Fig. 1 shows the hairline and the actual blade cut.

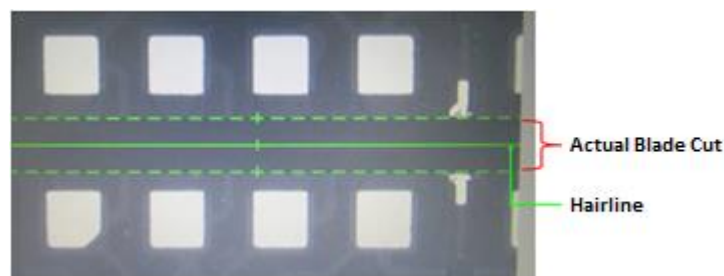


Fig. 1. Blade cut aligned with the hair line

Fig. 2 shows the first cut line alignment on the machine that was not needed for adjustments. The hairline of the machine was aligned with the saw street of the strip. On the other hand, Fig. 3 illustrates cut line alignment that needs to be adjusted where the hairline was not aligned with the saw street of the strip.

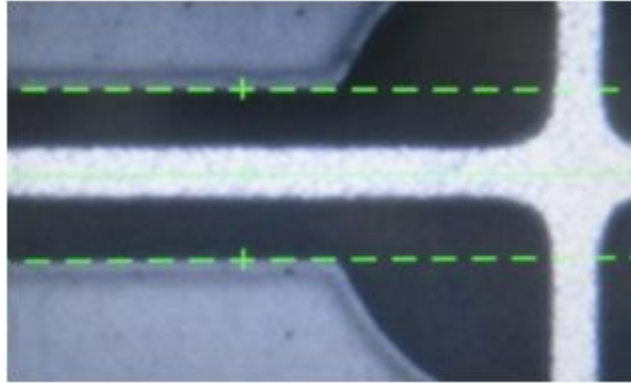


Fig. 2. Good alignment of hairline (green line) with the saw street

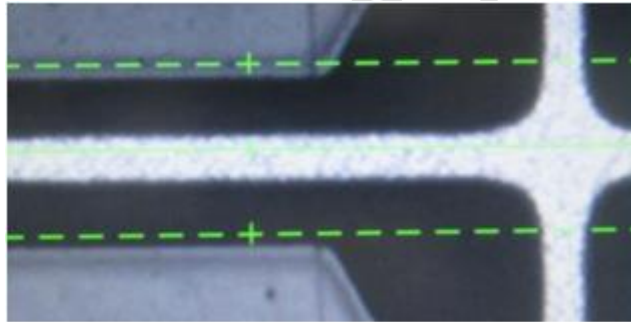


Fig. 3. Needs adjustment as hairline (green line) was offset with saw street

However, few strips that was verified to be aligned upon the first cut line, still encounters gross misaligned cut that was quantified and rejected after sawing. This was due to mismatch of actual unit pitching to the programmed unit pitching on the machine. The tendency was to have a compensation of unit pitching differences that will be developed to misalignment. Few strips need frequent assistance to align the cutting by adjusting the hairline of the machine and then closely monitored per strips.

With the data on hand, the next step is to establish the best assistance that the shopfloor can perform upon encounter of mismatched unit pitching entrapped during vertical indexing (Y-indexing) verification on the strip under singulation.

Current practice on the shopfloor was to adjust and purposely offset the hairline alignment from the actual blade cut. The effect of adjustment will be applied on the next cut line. However, next cut lines might give off different alignments along the processing. Close monitoring was performed but the problem will not be resolved. The succeeding strips are

expected to be assisted same with the previous strips, and another batch of lots will have another adjustment.

2. METHODOLOGY

The authors were engaged to find the best assistance that can be performed in the occurrence of strips affected with mismatched unit pitching. Brainstorming was done about the importance of sub-index checking prior proceeding the lots on top of the verification of first cut line alignment. Works and studies shared in [1-7] focused on the cutting method, design, and pattern recognition were helpful in this study. The authors have also studied about the existing assistance to adjust the hairline to catch up with the correct alignment. Program teaching was explored for the efficiency to address the issue.

2.1 Understanding the Importance of Sub-Index Checking

In singulation process, sub-indexing refers to the movement and distance travels during scanning for alignment inspection. Two sub-indexes are being monitored which are the horizontal indexing (X-indexing) and vertical indexing (Y-indexing). X-indexing is where scanning inspection goes from left to right or vice versa. Y-indexing on the other hand, is where the scanning inspection goes from up to down or vice versa. Figs. 4 and 5 demonstrate the X-indexing and Y-indexing, respectively.

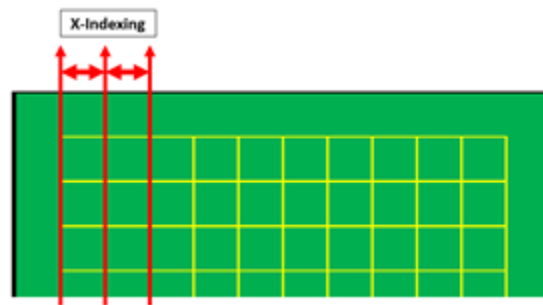


Fig. 4. X-indexing – horizontal travel movement



Fig. 5. Y-indexing – vertical travel movement

X-indexing was used to ensure that the cutting was aligned from the start and finish of the strip. Misalignment and slanted cuts can be verified by using the X-indexing along the strip. Y-indexing was used to verify the consistency and matching of actual unit pitching to the programmed unit pitching on the vertical movement. Through Y-indexing, it can be predicted if the succeeding cut lines might have offset cut due to mismatched unit pitching brought about by the strip imperfections induced by the assembly process steps that the strips have undergone.

Through understanding of sub-index function and importance, it has been found out that Y-indexing can be used to predict the succeeding cut line alignment. Mismatched unit pitching that might result to misaligned and offset cut can be expected and corrected as early as the first cut line verification.

2.2 How Hairline Adjustments Affects the Cutting Alignment

Upon entrapment of mismatched unit pitching during singulation, the hairline of the machine can be adjusted to purposely create offset from the actual blade cut. Hairline is the predictive line on the machine where the blade will saw through. Machine aligns the blade with respect to the hairline setting on the strip. Adjusted hairline can take effect on the succeeding cut lines of the strip.

Fig. 6 illustrates the cut line with aligned hairline and its succeeding cut line. The strip has consistent unit pitching as verified through Y-indexing until the end of the strip and is aligned on the unit pitching set-up on the line.

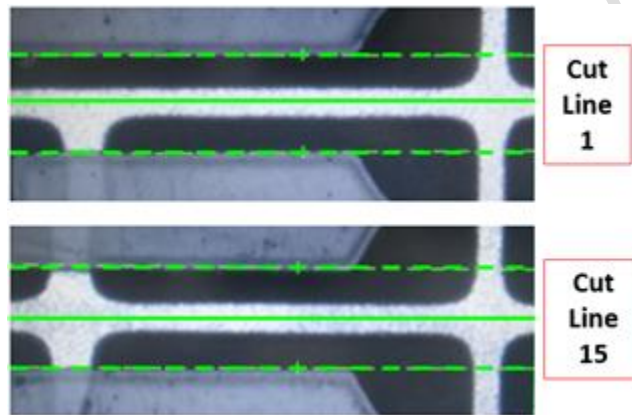


Fig. 6. Aligned hairline and consistent pitching

On the other hand, Fig. 7 shows an offset cut line as the strip progress. First cut line was aligned properly with the first cut line, but cut line 15 and cut line 30 has already misaligned hairline with respect to the saw street of the strip. The strip has mismatched unit pitching with the machine set-up as verified through Y-indexing. Accumulation of distance from mismatched unit pitching induces the potential offset cut.

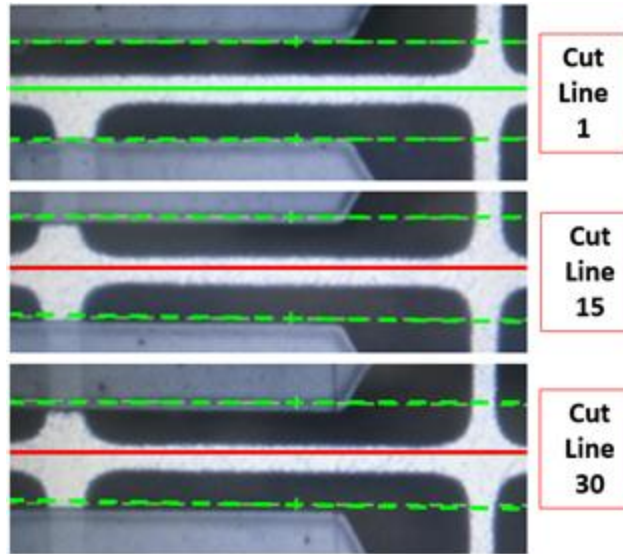


Fig. 7. Cut lines with different response

Aside on the frequent assistance of the shopfloor to adjust the hairline, unit pitching of machine set-up to the actual pitching of the units at the strip can be changed through program adjustments. The authors have explored the idea to perform parameter adjustment on the affected strips to find out if it can be effective. Also, as observed with the strip batches, the mismatched pitching that was encountered on the first strip was the same with the succeeding strips of the same batch. Thus, adjustments to match the actual unit pitching of the strip to the machine set-up can be performed and utilized per batch of lots.

2.3 Assistance Through Sub-Index Unit Pitch Adjustment

With the strip being verified and predicted to encounter offset cutting as the strip progressed the singulation process, unit pitching can be adjusted to cater and match the actual unit pitching of the strip. This can be changed through adjusting the value of unit pitch at the sub index parameter page. Fig. 8 shows the page on the machine where the unit pitch can be changed.

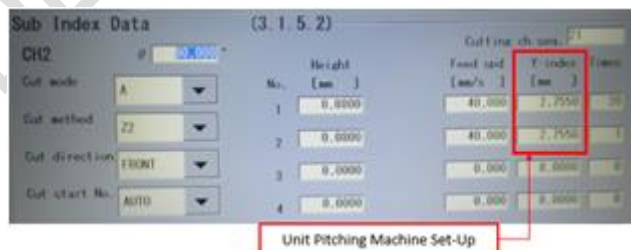


Fig. 8. Sub index parameter page

Sub-index on CH1 or CH2 can be adjusted for Y-indexing, which corresponds to the unit pitching. The chuck table of the machine which holds the strip moves only upward and downward which corresponds the y-movement that moves per unit pitch. Blade movement is horizontal which corresponds to the X-indexing.

Strips reacts and differs with the ideal condition after series of assembly process steps was being performed. Thus, considering the good strips was essential to be the reference strip of the new unit pitch adjustment.

3. RESULTS AND DISCUSSION

The methodology that was conducted have assisted the authors to arrive on the results and discussion of addressing the mismatched unit pitching observed during Y-indexing.

3.1 Matching the Unit Pitching

The example of mismatched unit pitching between the program set-up and the actual unit pitch was shown on Fig. 7. Machine program refers to the drawing and POA (need to define) of the strip, while the strip has inconsistent response that was induced by the assembly process steps.

Changing the value of unit pitching to match with the actual unit pitching of the strip resolve the potential offset cut issue. For example, the unit pitch at package outline assembly document as well as with the machine set up was at 2.750 mm. However, 12 microns were needed to match the actual unit pitching of the strip. The unit pitching machine set-up should be added with 12 microns which results to 2.762 mm. Any value can be inputted on the machine as the unit pitching. Fig. 9 shows that hairline was already aligned with the saw street of the strip from first to last cut line after adjustment of parameter settings.

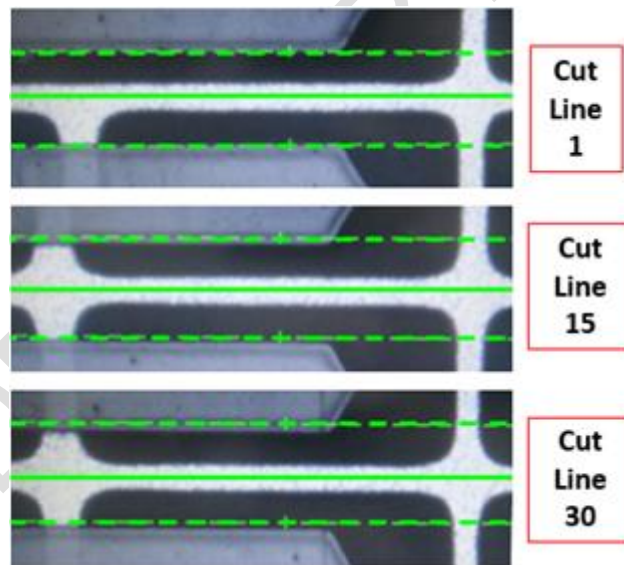


Fig. 9. Matched unit pitching after parameter adjustment

Matching the actual unit pitching of the strip to the machine program set-up have been verified to be effective approach to avoid offset cuts. Verification of y-indexing together with x-indexing at first cut line is essential to entrap and adjust the parameters as needed.

4. CONCLUSION AND RECOMMENDATIONS

With the study conducted, the occurrence of gross misalignment brought about by the mismatched unit pitching of the actual strip and machine program was mitigated upon

proactive approach to verify the Y-indexing of the strip. It was noted that the occurrence of mismatched unit pitching can be found per batch of processing. This also can be corrected with adjustment of unit pitching to match the actual unit pitching of the strip instead of frequent assistance per during processing of the lots.

It is highly recommended to include the Y-indexing verification together with the X-indexing conducted on the first cut line of the strip loaded on the machine during the process. The parameter adjustment is critically important to match the actual unit pitching. Note that frequent adjustment of hairline to compensate with the alignment was tedious and risky to aggravate the occurrence of cutting misalignment. Maximizing equipment capability and error-proofing solution without acquiring investment supports the high-volume manufacturing performance of the assembly plant.

COMPETING INTERESTS DISCLAIMER:

Authors have declared that no competing interests exist. The products used for this research are commonly and predominantly use products in our area of research and country. There is absolutely no conflict of interest between the authors and producers of the products because we do not intend to use these products as an avenue for any litigation but for the advancement of knowledge. Also, the research was not funded by the producing company rather it was funded by personal efforts of the authors.

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