

Technical Note

Preventing false evaluation: Unifying the product orientation



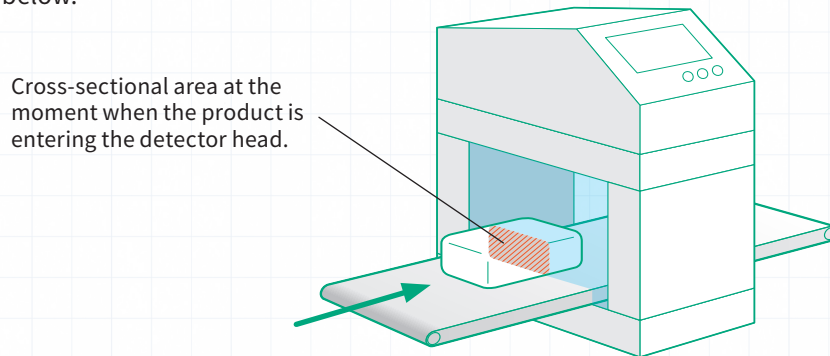
Metal Detector



A metal detector creates a magnetic field in its detector head and monitors a change in a magnetic field when a product passes it through. When the signal exceeds the set value (threshold), it evaluates the change as a metal contamination. In this paper, we explain through experiments how the direction in which the product enters the detector head changes the product effect value and evaluation for PASS/Defective products.

1. Inrush cross section depending on the orientation of the product

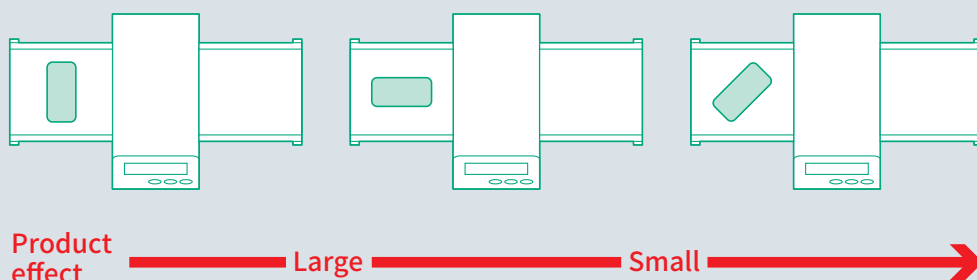
"Inrush cross-sectional area" may not be familiar to you, but consider it as the cross-sectional area of the product when it enters the detector head viewed from the traveling direction of the product as shown in the image below.



The product effect value by "inrush section area" basically changes as shown in the illustration below.

Variations in conveyance condition

The effect on the magnetic field changes when the conveyance speed or the orientation of the product changes.

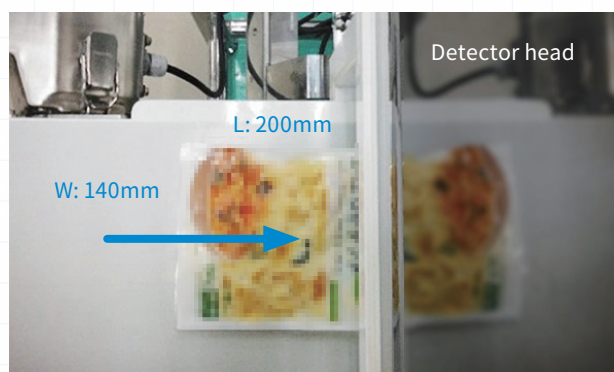


If the "inrush cross section" is small, the number of magnetic flux lines striking the product to be inspected becomes small. Also, if the "inrush cross section" is large, the number of magnetic flux lines striking the product becomes large. If a large number of magnetic flux lines hit the product, the disturbance of the magnetic field increases, which is one of the factors that increase the product effect value. Since the product effect value is close to the evaluation limit, faulty evaluation may occur depending on the direction in which the same inspected product enters the detector head.

To facilitate the understanding of the above, we performed the following experiment. Side-dish product in a standing pouch (size: 200 mm x 140 mm x 30 mm) was conveyed in the vertically long direction (W: 140 mm, L: 200 mm) to perform product registration*. The detection limit (threshold) is set so that a signal exceeding five times the product effect value is detected as metal contamination (blue frame in the lower left image). The product effect value when conveying in the vertically long direction is indicated by two to three green bars blinking. This condition is evaluated as a PASS product (OK).

Next, the product was conveyed in the horizontally long direction (W: 200 mm, L: 140 mm). The indicator of the product effect monitor reaches red, indicating that the detection limit set at 5 times has been exceeded (the following right image with a red frame). This is an example in which the inrush cross-sectional area is increased because the product, which was registered in the vertically long direction, was fed in the horizontally long direction. The product effect value exceeded the detection limit, so it is erroneously evaluated as a foreign object (defective product).

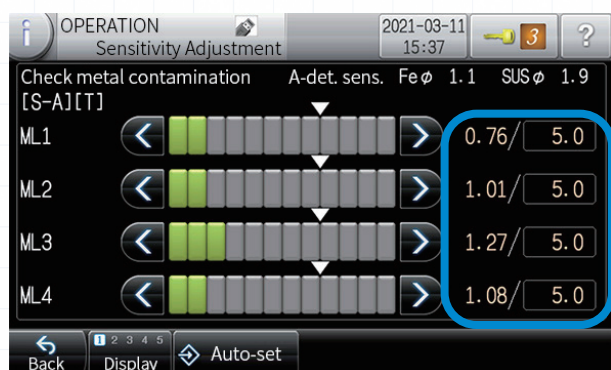
* Only a product to be inspected is fed to the detector head 5 to 10 times to measure the effect of a product on the magnetic field.



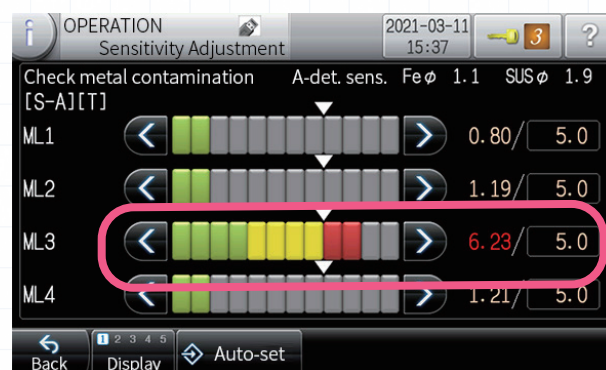
When feeding in the vertically long direction



Feeding in the horizontally long direction



Product Effect Value: OK



Product Effect Value: NG

2. Why does the product change its direction?

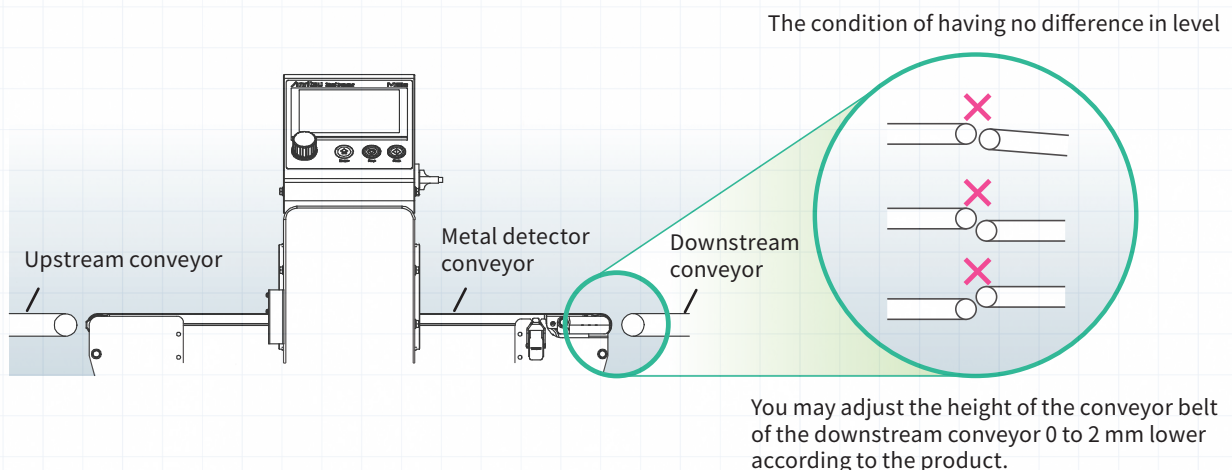
Why does the change in the product orientation happen drastically that can affect "inrush cross section"? One or a combination of the following three factors can be the cause.

1. The height of the right and left sides of the conveyor used to carry the product is out of balance.
2. In addition, there is the difference in the height of conveyors between the inspection system and upstream equipment.
3. Moreover, there is a speed difference between the conveyor of the inspection system and the conveyor of the upstream equipment.

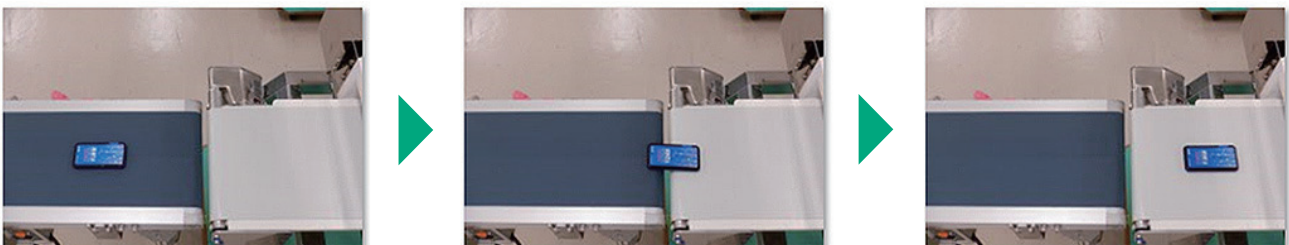
*Depending on the product, a slight level difference can be provided to improve the transfer of products, or a speed difference can be applied to widen the distance of products.

1. The height is not balanced on the left and right sides of the conveyor.

The following are the precautions described in our operation manual. It gives an alert to the user not to make a large difference in height between the upstream conveyor and the conveyor of the metal detector. It is the same as when we walk on the road, if there is a bump, we may lose our footing and brake our posture. Moreover, the point to be noted in this paper is that the height of the left and right sides of the conveyor used to carry the product is not balanced.

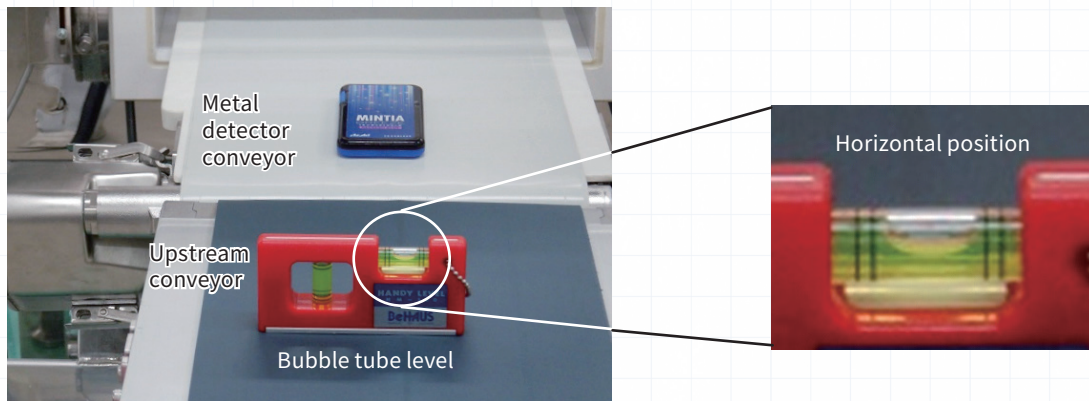


First, we experimented to see how the product transfers from the upstream conveyor to the metal detector's conveyor with the right and left heights balanced.

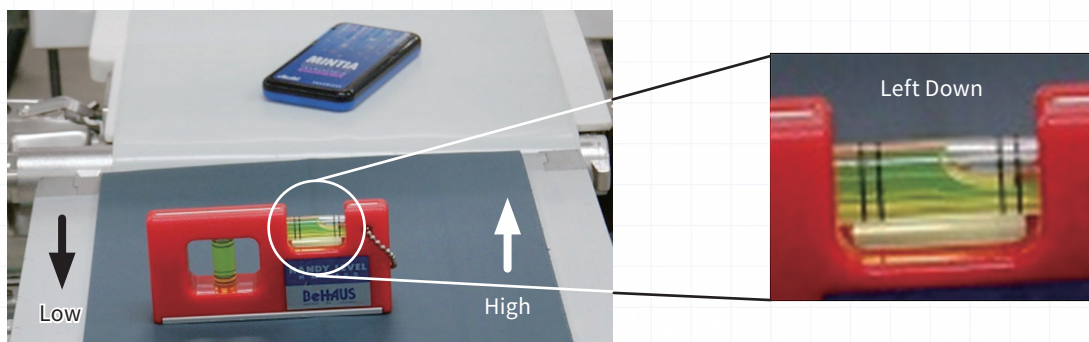


The orientation of the product remains constant even if it moves from the upstream conveyor to the metal detector conveyor.

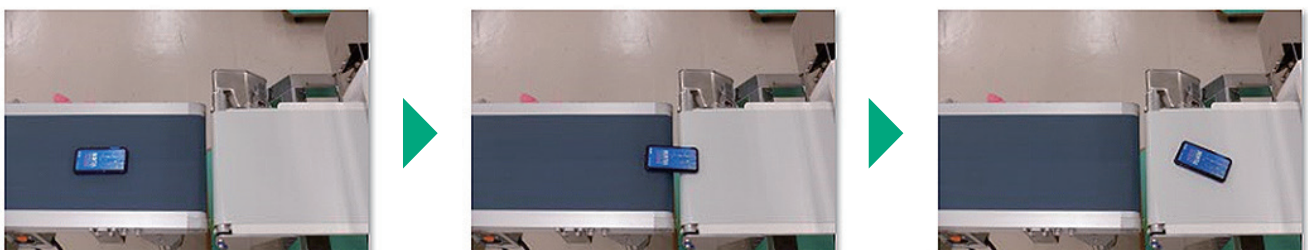
We place the bubble tube level on the upstream conveyor. You can see that the bubble is in the middle. In this state, the height is balanced between left and right.



Take a look at the picture below. When you put the level, the bubble is on the right side. At this time, the height of the upstream conveyor is out of balance on the left and right sides.

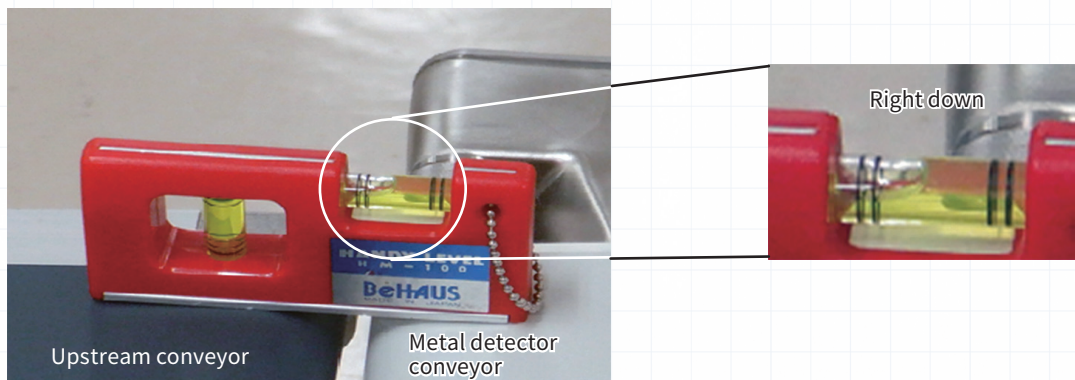
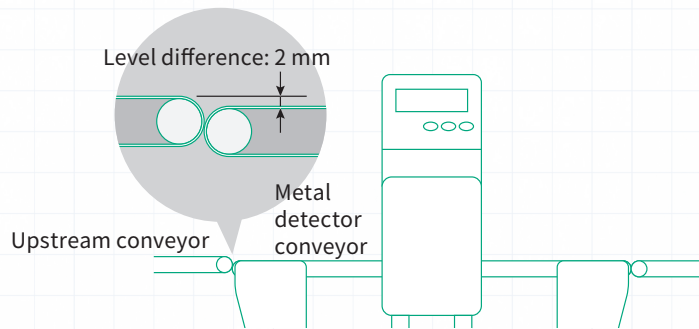


In this state, we are going to feed the product. The speed of the upstream conveyor and the conveyor of the metal detector is matched.

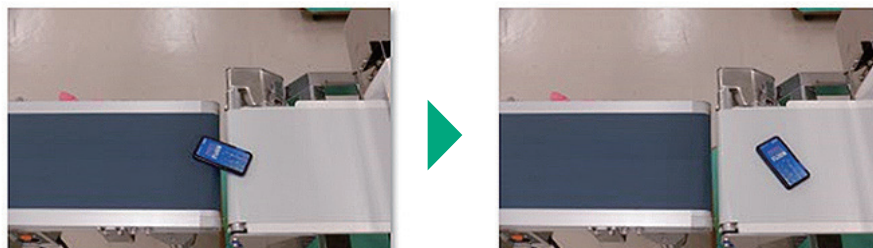


The direction of the product has changed considerably. However, the orientation does not change completely from vertical to horizontal, so false evaluation does not occur.

Next, make the conveyor of the metal detector a little lower than the conveyor at the upstream. From the front, it looks like this in the below image.



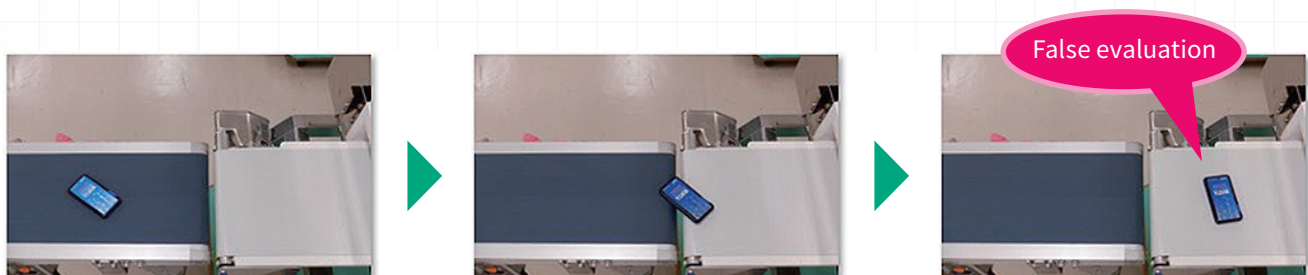
When you place the level, the air bubbles will move toward the upstream conveyor side. This indicates that the metal detector conveyor is lower in height than the upstream conveyor. We try to feed the product when there is a level difference between the upstream conveyor and the metal detector conveyor, and the height of the left and right sides of the upstream conveyor is not balanced.



The deviation of the product orientation becomes larger than before. This can cause the metal detector to generate a false evaluation.

Although experiments are not performed, if there is a speed difference between the upstream conveyor and the metal detector conveyor, and the left and right sides of the upstream conveyor are not balanced, the change in the orientation of the product will be large as well.

If there are multiple conveyors in the previous process and a similar imbalance occurs, the change in the product orientation gradually increases, and the possibility of false evaluation by the metal detector increases.

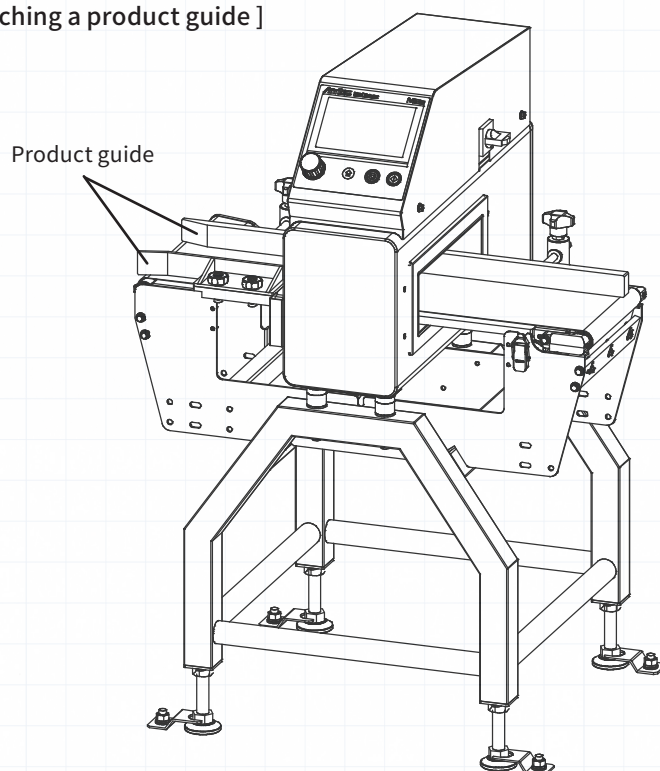


3. Solution

If the metal detector or the upstream conveyor has been moved from a different line or has returned from a manufacturer's take-back repair, check with the level to make sure that both the upstream conveyor and the metal detector conveyor are well balanced. If they are out of alignment, adjust the height of the conveyor's legs.

When a product passes through the upstream conveyor, the orientation of the product may have already been shifted. In general, a product guide is attached on the conveyor to correct the product orientation. However, if the position of a product guide is not appropriate, the distance between a product and a next coming product may become shortened, or the conveying position may be disturbed. So please be aware of this when operating a machine.

[Example of attaching a product guide]



Conclusion

We hope this paper helped you understand the change in the direction of the product to be inspected (inrush cross section) is closely related to the product's effect value and the pass/fail evaluation. Depending on the weight of the product and the packaging form, it may be difficult to change the direction, so keep monitoring how often false evaluation occurs for each product. Please check to see if the inspection line is operated with the correct knowledge and share the information in the workplace to make effective use of the metal detector.

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