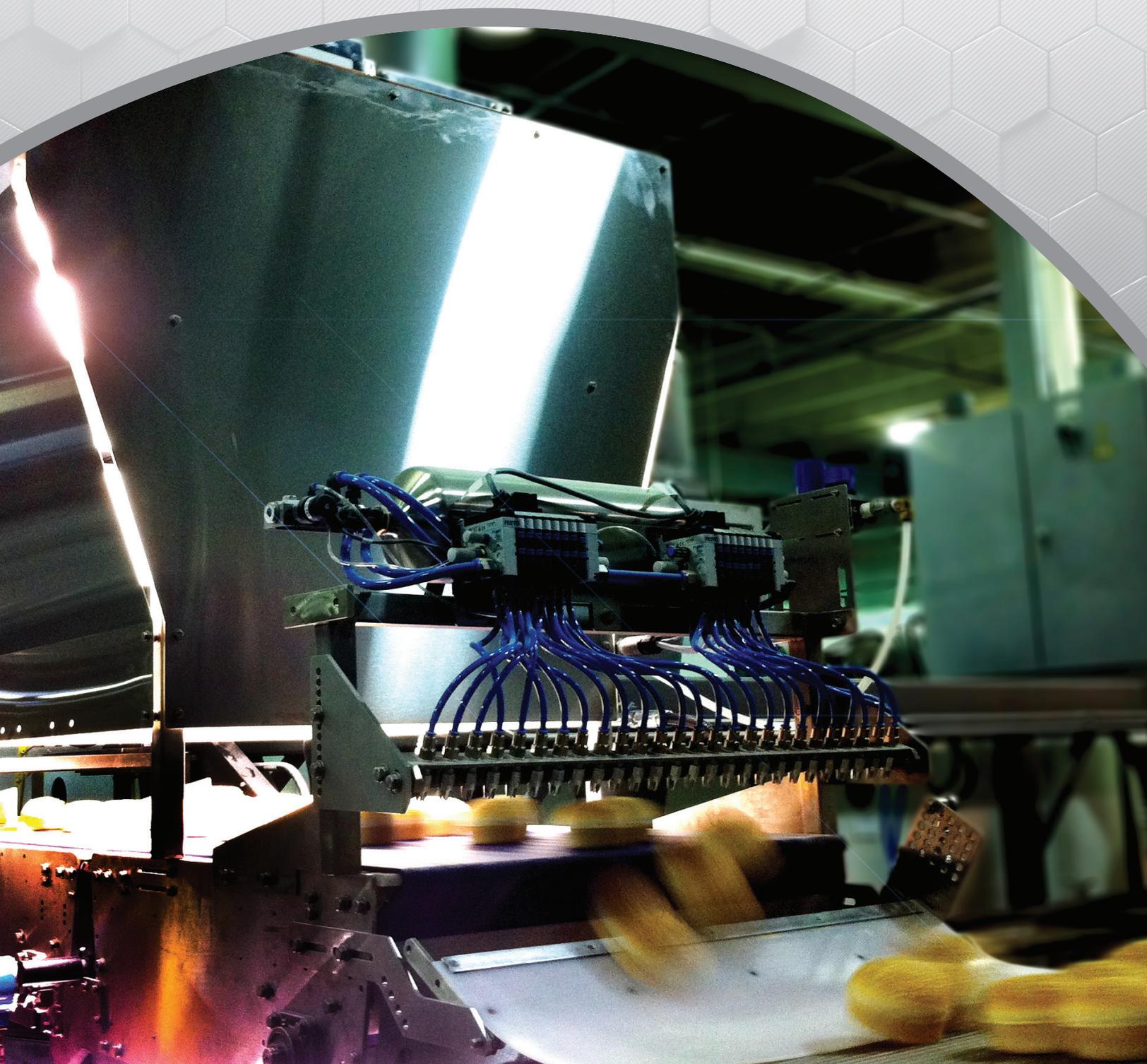


WHITEPAPER: SORTING MECHANISMS



Automated Sorting Solutions for the Production of Processed Foods

Automated Rejection and Recirculation Mechanisms



1. Introduction

Optimizing the flow of product through your production line is key to driving profit. Installing an in-line or over-line Automated Inspection System at one or more points serves to identify non-conforming items based upon a range of customizable test criteria, and when coupled with the right Automated Sorting Process, can radically increase throughput efficiencies and the quality of your product. These Automated Inspection Systems incorporate high-speed cameras with imaging software to detect and measure objects at full-line speeds.

This whitepaper focuses upon the sorting mechanisms in common use for the production of processed food products, particularly highlighting rejection and recirculation. It is intended to assist manufacturing and operations personnel seeking to implement a fully automated solution in understanding some of the options available to the market and the considerations that should be taken into account when implementing such systems.

This whitepaper focuses upon the sorting mechanisms in common use for the production of processed food products, particularly highlighting rejection and recirculation.

2. Selection Criteria

When selecting the best sorting technology to pair with your inspection system, there are a number of important considerations that should be factored into an evaluation. These include; the physical properties of the product being inspected, the speed (i.e. throughput) of the production line, the configuration of the production line, material handling requirements for the specific application, and compliance reporting requirements.

In some cases, the value of a rejected non-conforming item may recommend re-processing versus disposal of that item. In such cases, item redirection systems can be used in place of rejection systems to re-route the flagged product for secondary inspection or further processing. An example of this would be a unit of poultry, which may not meet the required portion size requirement to be processed as a frozen chicken breast, but may still be suitable for use in breaded chicken nuggets if processed appropriately.

PHYSICAL PROPERTIES OF PRODUCT

The physical properties of the product being inspected will dictate the sorting solutions best suited to your application. For example, when dealing with relatively small and lightweight baked goods including buns or cookies, air jets can often be installed above or to the side, to isolate and reposition individual items with great precision. For larger items, including loaves of bread, a servo-driven paddle, pusher system, or other product-specific rejection system will typically prove more effective. Size, weight, surface area, texture and dry vs. wet should all be taken into account.

PRODUCTION LINE CONFIGURATION

The configuration of a production line will also contribute significantly to the rejection sorting method that should be used. The surface texture, width, speed and physical constraints of the conveyor and surrounding environment are all factors that must be accounted for.

For production lines requiring regular washdown, the inspection system will typically be delivered to meet IP69K standards. It is important that the rejection sorting system also meet these environmental standards to ensure the reliability and safety of the combined system.

METHOD OF REJECT CAPTURE

The manner in which rejects are captured will be influenced by the expected disposition of those products. If non-compliant goods will simply be disposed of, then the primary consideration will be the volume of the capture container which in turn will be a function of the size of the product and the expected rates of rejection. Another factor to be considered for disposal situations should be the mobility and accessibility of the capture bins.

Depending upon the inspection system installed, it may be possible to create alerts for reject bin capacity to instruct personnel to empty or replace as appropriate.

REWORK CONSIDERATIONS

If your product is suitable for reworking, many of the rejection methods below can assist to redirect appropriate products for manual inspection or to a secondary processing line. When a vision inspection system is incorporated into the manufacturing process, detailed images and data associated with repurposed products allow manufacturers to gain insight regarding process issues and to keep track of batches involving reworked ingredients.

Reviewing historical data provides the opportunity to analyze positive or negative trends and make adjustments where needed to improve quality and reduce costs.

COMPLIANCE AND ANALYTICS

Analytics, via integrated reporting or customized Statistical Processing Control (SPC) software, is a critical component of modern food manufacturing plants. Having instant and easy access to production and QA data allows you to make time-sensitive decisions, track rejected and recirculated product, comply with customer and regulatory requirements and ensure the most efficient operation.

Reviewing historical data provides the opportunity to analyze positive or negative trends and make adjustments where needed to improve quality and reduce costs.

3. Inspection System Integration

Inspection systems and their configured software will often have the ability to control PLCs (Programmable Logic Controllers), which can in turn drive other elements of the production process, including automated rejection systems. Once the inspection system has identified a non-compliant item, the software will instruct the PLC to activate the rejection system(s), which will in-turn remove the non-compliant item from the conveyor for disposal, or in some cases, redirect the item to a secondary process.

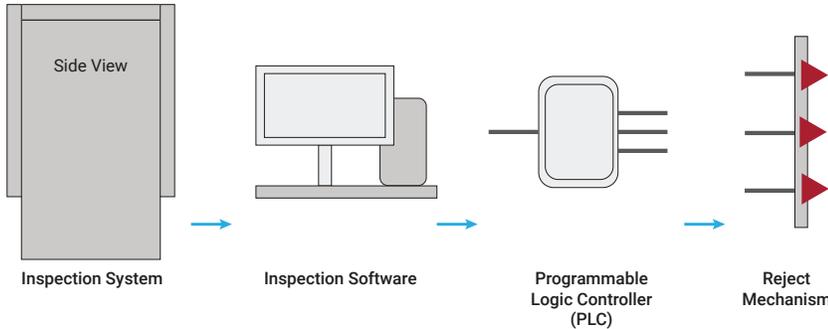


Figure: Inspection System Integration with Reject Mechanism

4. Types of Rejection Systems

The full range of rejection systems available is vast, and some would be beyond the scope of this whitepaper. We will however provide a meaningful selection of rejection technologies in common use.

For goods flagged for further inspection or alternative processing as opposed to simple rejection and disposal, it is common to employ diverter mechanisms to move identified products to a secondary conveyor or capture system. These solutions are referred to as “divert” or “diverter” systems throughout this section.

CONVEYOR SHUTDOWN

In this most simple scenario, the inspection system having flagged a non-conforming product will stop the conveyor belt and sound an alarm calling for production staff to review the rejected product and to manually remove it from the production line as appropriate.

Two of the primary advantages of pneumatic rejection systems are that they offer very fast response times, and typically have no moving parts, requiring only minimal maintenance.

AIR JET REJECTOR

Air jet manifolds installed in proximity to the inspection system offer a flexible and reliable methodology to reject products possessing higher surface area to weight or height to weight ratios. Air blasts produced by individual jet nozzles can accurately target individual items that have fallen outside of configured measurement criteria even in multi-lane production lines.

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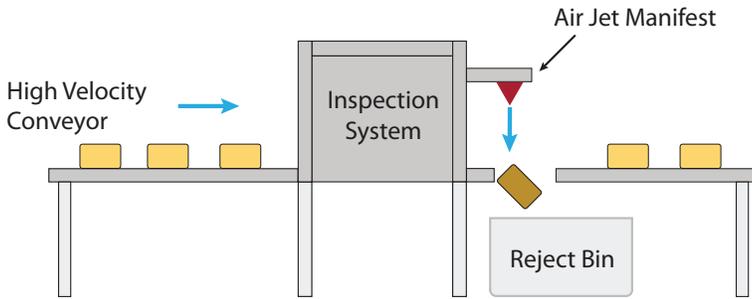


Figure: Side View of Top Mounted Air Jet Rejector (single or multi-lane)

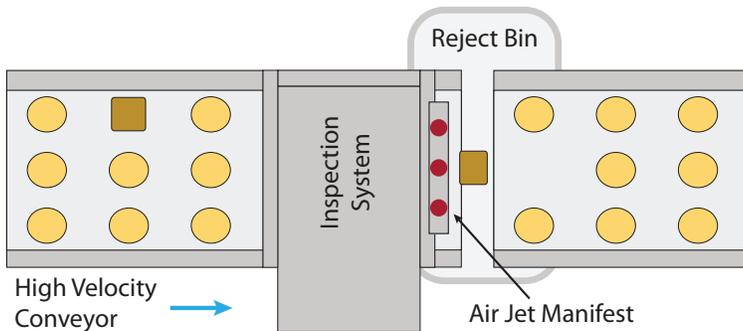


Figure: Top View of Top Mounted Air Jet Rejector (single or multi-lane)

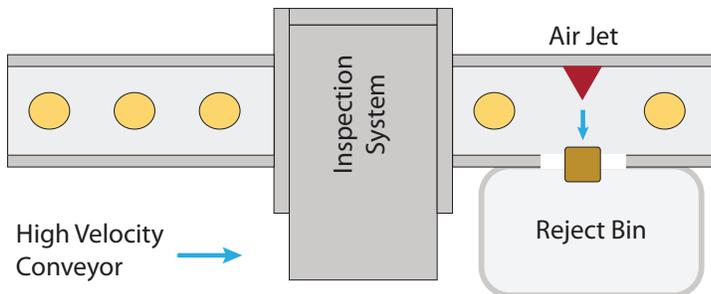


Figure: Top View of Side Mounted Air Jet Rejector (single-lane)

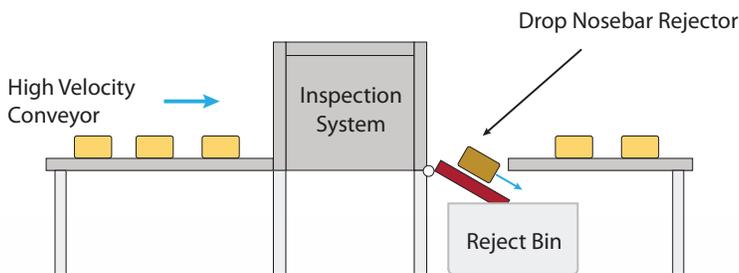


Figure: Side View of Drop Nosebar Rejector (single-lane)

Examples of processed food products suited to air jet rejection include small to medium baked goods including round buns, english muffins and even bagels.

a) Top Mounted Air Jets

When installed in conjunction with a split conveyor, top-mounted air jets can provide an effective and accurate means of automatic rejection for multi-lane lines for products exhibiting favorable surface area to weight ratios.

b) Side Mounted Air Jets

Side-mounted air jets can be ideal for rejecting lighter weight products with positive height to weight ratios being processed in single-lane conveyor lines for products exhibiting favorable height to weight ratios.

NOSEBAR REJECTORS

There are a number of conveyor “nosebar” rejection systems available which will drop, lift or retract a section of the conveyor in order to reject or divert non-conforming product.



Frozen pizza crust on a drop down paddle rejector conveyor

a) Drop Nosebar

Drop nosebar rejector conveyors can be highly effective for lower-profile, less rigid and heavier products being processed in single-lane conveyor lines. Drop nosebar rejectors will temporarily lower a section of the conveyor to redirect the non-conforming product into a reject bin, or alternatively, to an alternate conveyor path for re-processing.

Examples of products well suited to drop nosebar rejection systems include flat baked goods such as pizza shells, topped pizzas, and tortillas.

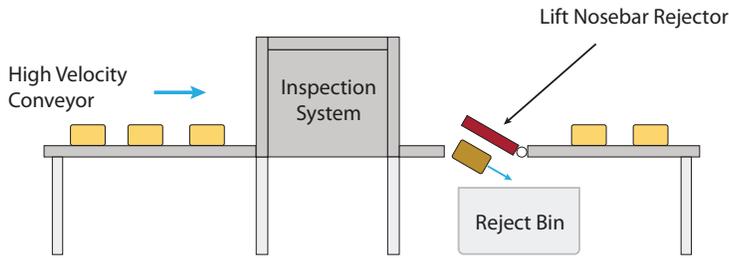


Figure: Side View of Lift Nosebar Rejector (single-lane)

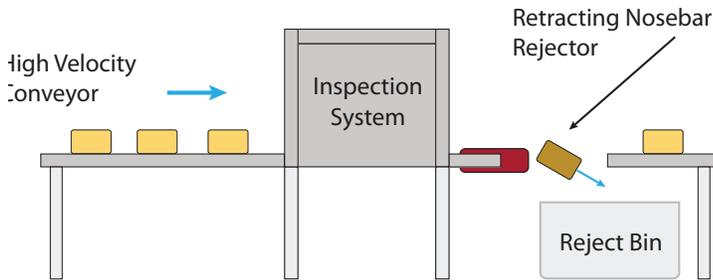


Figure: Side View of Retracting Nosebar Rejector (single-lane)

b) Lift Nosebar

Also referred to as a “pop-up” rejector, the lift nosebar rejector causes a segment of the downstream conveyor to temporarily lift, allowing the rejected product in a single-lane production line to fall into the reject capture bin.

Similar to the drop nosebar rejector system, the lift nose rejector is well suited to processed food products including pizza shells, topped pizzas, and tortillas.

c) Retracting Nosebar

Retracting nosebar conveyor rejection systems can be employed for larger and heavier items being run in single-lane production lines. In these systems, a section of the conveyor can be retracted to create a gap in the production line into which rejected items can fall. Once the suspect product has been captured in the reject bin, the conveyor nosebar assembly will return to its original position, allowing compliant items to continue down the line.

PUSHER REJECTORS

Pusher rejectors are linear actuators that can be driven by pneumatic, hydraulic or electrical means. They are well suited to single-lane production lines and larger products. Push rejectors will rapidly push the flagged item into a reject bin, or in some cases to an alternate production lane, allowing the compliant goods to continue down the line unimpeded.

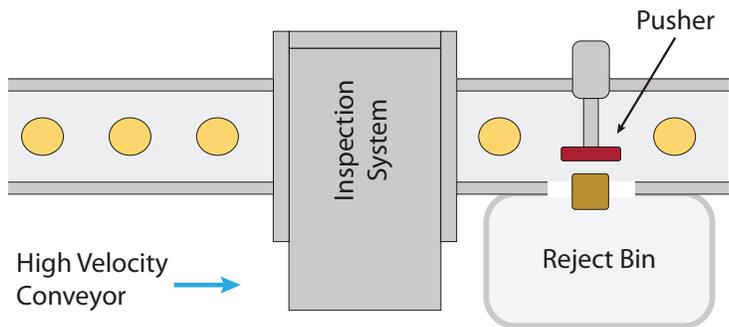


Figure: Top View of Push Rejector (single-lane)

Examples of processed food products suited to push rejectors include bread loaves or packaged goods.

SWEEP ARM REJECTORS

A sweep arm rejector is configured to swing across the line conveyor, diverting non-conforming product to a reject bin, or alternatively, to a secondary conveyor for re-processing. Sweep arm rejectors are best suited for medium weight goods being processed in a single-lane production line.

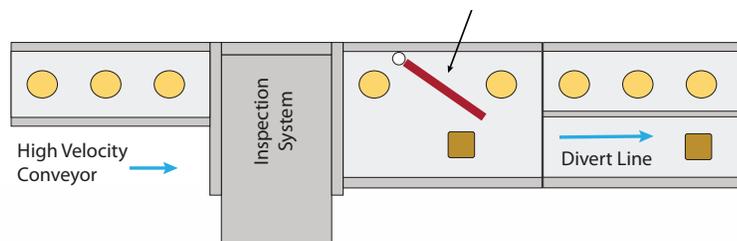


Figure: Top View of Sweep Arm Rejector (single-lane)

Examples of processed food products well suited to sweep arm rejectors include poultry and other meats products either raw, cooked or breaded, as well as canned and packaged goods that may fail packaging and labeling inspection criteria.

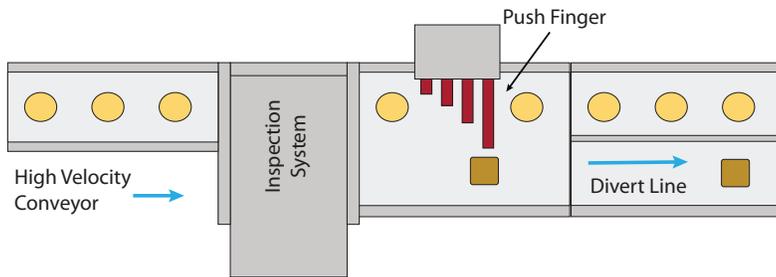


Figure: Top View of Push Finger Rejector (single-lane)

PUSH FINGER REJECTORS

Push finger rejectors can serve a similar function to sweep arm rejectors, and are typically used for divert applications, push finger rejectors can gradually and with minimal force, reposition a product on a conveyor, directing it to a secondary inspection or processing line.

5. Conclusion

Selecting the appropriate sorting solution to complement an automated inspection system can dramatically increase production throughput and quality. Accounting for the physical properties of the product being inspected, the configuration of the production line and other material handling factors are critical inputs to this decision.

Used in conjunction with Over-Line & In-Line inspection systems, the software allows for automatic rejection, ensuring that defective objects never reach the end customer. Rejection limits are completely configurable and allow reject decisions to be more predictable and repeatable. Detailed records of rejected product are maintained in a database, allowing for detailed reporting and data visualization via analytics.

Selecting the appropriate sorting solution to complement an automated inspection system can dramatically increase production throughput and quality.

KPM Analytics is a leading provider of vision technologies to help food manufacturers implement quality control and production automation solutions. These systems deliver objective, meaningful, and actionable measurements in a production environment at full-line speed. Whether as a benchtop unit or a fully-integrated in-line system with process control, food manufacturers can realize cost savings, efficiencies, and product quality improvements nearly immediately with vision technology systems.

Contact us today to learn how vision inspection systems can help you optimize your production processes and craft a fully automated inspection strategy for your specific requirements.

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