

X-Ray: A solid investment to improve food safety and quality.

Food safety, brand protection and an overall commitment to satisfying the consumer are all key aspects to producing a quality food product. There are many levels to food safety from pathogen traceability to physical contaminant detection with the overall goal to provide consumers with the safest food available. Quality control personnel have a daunting task to keep our food safe and their respective brands free from negative press.

X-Ray technology is a proven solid solution for eliminating physical contaminant detection concerns. This relieves the quality control team to focus on other aspects of the food safety paradigm. X-Ray systems dedicated to food inspection have been around the industry for over 20 years. Within the past 9 years, significant advancements in detection accuracy, speed, pricing, and most importantly, reliability, have allowed this technology to become a proven warrior against the physical contaminant concerns. Metal, glass, stones, and bones are introduced to the food chain in various ways. Glass can be introduced when a beer bottle is tossed from a car into a farm field and picked up by the harvesting equipment. Bolts and other metals can enter during the raw material transportation process. Hypodermic needles are broken inside the animal by veterinarians when administering medications. Small metal shavings or sieve wires are introduced when processing equipment fails. And of course, bones from pork, beef or chicken, are introduced during processing with the wish bone being an important bone to detect due to its inherent choking hazard for children. One should consider the consequence of just one major contaminant recall to your business; fixed and unquantifiable costs.

X-Ray Technology provides additional benefits beyond contaminant detection. Often, other higher priority or higher quantity consumer complaints can be solved using x-ray technology. Simultaneous to contaminant detection x-ray technology can act in a number of different product quality applications currently not available with any other technology such as:

- ✓ the virtual checkweigher
- ✓ counting the number of units within a package
- ✓ analyzing for broken product
- ✓ looking for product trapped within a flow wrap or meat packaging seal
- ✓ inspecting through metallic packaging without any degradation to contaminant accuracy
- ✓ analyzing fill levels
- ✓ product quality imaging aspects

The mechanical aspect of the technology seems simple and relatively straight forward for companies investigating other equipment solutions. However, the actual implementation of the x-ray build and implementation on a production line maximizes the system's benefits to an organization. This is critical to the success of x-ray technology as the market expands. A system needs to be accurate, stable, and repeatable and maintain a virtually zero false reject rate for users to gain trust in the actual reject. High false reject rates create a loss of one's confidence in any technology. In this regard, X-ray systems can be classified into two categories: Entry level and Advanced level.

Entry levels systems are priced and built to improve upon the standard metal detection technology most processors are using today. These systems are low priced units and provide *some* increased accuracy over metal

detection while providing the ability to inspect through metallic packaging. Advanced Level systems are designed to maximize results and offer significant value; providing a huge accuracy improvement over metal detection and entry level x-ray systems in addition to providing benefits beyond contaminant detection.

Purchasers need to consider their own quality goals. If the investment in x-ray technology is to effectively detect the smallest pieces of metal and more importantly, lower density contaminants that are often found in many harvested products, x-ray technology is an important investment option to consider. Entry level systems provide low density contaminant detection but not to the extent required by manufacturers, *their* customers or to the consumer. So again, it is important to define your project goals and keep your focus on improving product quality to eliminate all physical contaminant concerns. Another longer term aspect that needs to be understood is that contaminant specs do not become more “lax” but rather more stringent as food safety laws become more prevalent in today’s marketplace. Superior food quality is becoming a more popular topic of conversation amongst our colleagues with respect to preserving product integrity as perceived in the eyes of the consumer. Therefore, justifying the investment in the advanced x-ray solution may be more appropriate to satisfying long-term goals and flexibility.

APPLICATION: DISPLAY PACKAGE OF GUM WITH STACKED FOIL BLISTER PACKS			
	Metal Detection	Entry Level X-Ray	Advanced X-Ray
Ferrous Metal Detection	NO	1.5mm to 2.0mm	0.4mm to 0.7mm
Non-Ferrous Metal Detection	NO	1.5mm to 2.0mm	0.4mm to 0.7mm
Stainless Metal Detection	NO	1.5mm to 2.0mm	0.4mm to 0.7mm
Wire Detection	NO	1.5mm Diameter	0.2mm/0.5mm dia x 2mm long
Glass Detection	NO	4.0mm to 5.0mm	1.0mm to 3.0mm
Virtual Weighing	NO	N/A	+/- 1% to 2%
Missing Item Analysis	NO	N/A	One Missing Piece of Gum
Inspection in Metallic Pkg.	NO	YES	YES
Shape Analysis	NO	NO	YES
Broken product Detection	NO	NO	YES
Packaging Masking	NO	MAYBE	YES
False Reject Rate	N/A	1% to 2% estimate	Virtually 0% due to flexibility in software and stability of x-ray kit

APPLICATION: Packages of Ham Lunch Meat, 50mm in height			
	Metal Detection	Entry Level X-Ray	Advanced X-Ray
Ferrous Metal Detection	1.5mm	1.0mm 1.2mm	0.5mm to 0.7mm
Non-Ferrous Metal Detection	2.0mm	1.0mm 1.2mm	0.5mm to 0.7mm
Stainless Metal Detection	2.5mm to 3.0mm	1.0mm 1.2mm	0.5mm to 0.7mm
Wire Detection	Can be missed due to orientation	1.2mm diameter	0.4mm dia x 2mm long
Glass Detection	NO	4.0mm to 5.0mm	1.0mm to 2.0mm
Bone Detection	NO	3.0mm to 4.0mm	1.0mm to 2.0mm
Virtual Weighing	NO	MAYBE	+/- 1% to 2%
Missing Item Analysis	NO	N/A	YES - Depends on Packaging
Inspection in Metallic Pkg.	NO	YES	YES
Shape Analysis	NO	NO	YES
Product in Seal	NO	NO	YES - Depends on Packaging
Packaging Masking	NO	MAYBE	YES
False Reject Rate	N/A	1% to 2% estimate	Virtually 0% due to flexibility in software and stability of x-ray kit

X-Ray Technology is stable and versatile. Lets first compare the metal detector (MD) with an x-ray and later we'll discuss other applications. Many feel that the initial investment in an x-ray solution is avoidable and that the metal detector will "do the job" just as well. Although the metal detector carries with it many advantages, the disadvantages far outweigh the initial cost of the more advanced x-ray detection accuracy in its appropriate application. Did you know that metal detection technology is also affected by changes in environmental conditions? The x-ray technology carries with it an ability to overcome these environmental changes; whereas metal detector accuracy is affected by the variability of the product's ingredients and temperature known as "product effect." Also, vibration or noise from frequency drives can cause "head instability" and "false detection." A second issue that is common with the metal detector is its tendency to miss a metal wire of a significant length depending on the angle that they flow through the metal detector head. This is known as "orientation effect." The aperture size and often the frequency is designed specifically for the application which limits its effectiveness; while an x-ray system is versatile enough that you can adjust the software and x-ray power to successfully run small or large products through the same investment. And finally, when a metal detector rejects product, there is no visual indication that the product is actually contaminated and if detected; where it is located. X-Ray technology provides peace of mind as it is stable and reliable. X-Ray technology provides the operator with a visual representation of the location and physicality of the contaminant unlike the 'black box' symptoms of the metal detector, thus providing long-term flexibility from one investment.

METEL DETECTION v VISION SYSTEM v X-RAY TECHNOLOGY regarding contaminant detection capabilities			
	Metal Detector	Vision Systems	X-Ray Technology
Ferrous Metal Detection Accuracy	○		○
Non-Ferrous Metal Detection Accuracy			○
Stainless Metal Detection Accuracy			○
Metal Dust Detection Accuracy	○		
Low density ferrous metal Accuracy	○		
Glass, Stone and Bone Detection Accuracy			○
Ability to analyze for broken product within the package			○
Ability to Inspect through Metallic Packaging			○
Can detect twigs, bugs, leaves and other organic materials in bulk flow products		○	
Can detect burnt and mis-colored items in bulk flow products		○	
Can be used to analyze for proper labeling and coding		○	
Can be used to measure length, width and depth of products prior to packaging		○	○
Can be used to measure length, width and depth of products after packaging			○
No Negative Effect from Temperature Changes		N/A	○
No Negative Effect from Vibration Issues		N/A	○
No Loss in Accuracy from High Salt Content		N/A	○
No Loss of Accuracy from Metallic Packaging		N/A	○
No Accuracy Limitations from Aperture Sizes		N/A	○
Provide Long Terms Product and Packaging Change Accuracy		N/A	○
Ability to Visually Pinpoint a Contaminant		N/A	○
Ability to Store Reject Images for QA Support		N/A	○
Is not effected by recycled cardboard packaging.		N/A	○

Applications do exist where a metal detector is the proper choice alone or in tandem with x-ray technology. For example, if the solution calls for an installation on free falling product from a scale, a metal detector is the proper solution. Yet x-ray should be considered *after* the scale and bag packaging process to inspect the final product and ensure no additional contaminants were added in the bagging process and to detect product conglomerates such as salt clumping. Further, metal detectors are more accurate detector than x-ray technology for small and thin ferrous metals, metallic film materials within a product such as gum wrappers, and metallic dust. These items produce a significant and cumulative signal that is detected by the metal detector but do not create a significant density change visible by x-ray technology. For these reasons, food processing markets in Asia use both metal detection and x-ray technology as a complete solution.

Vision systems also provide additional and complementary benefits to x-ray technology. They inspect bulk harvested products such as raisins and nuts and processed items such as potato chips for various quality issues. These quality issues are detectable based on color, size, and shape. Twigs, leaves, bugs, stones, and glass can be rejected in nuts at high speeds. And color problems resulting from overcooked chips or fries can be detected and rejected as well. This again is not a 100% solution for contaminant detection because items such as stones could look like and 'act' like nuts, and green glass can be present in green vegetables yet these contaminants are more dense than the product and therefore easily detectable by x-ray technology. As a result, vision systems and x-ray technology are complements to one another to maximize your overall quality control program.

X-Ray is the inspection technology that is gaining a footing within the industry. With the recent advancements in detection capabilities, the investment in x-ray is now justified due to its ability to improve upon overall hidden and not previously seen contaminants. Again, these can be detected inside the product as well as within the packaging. Large food companies are demanding better performance for their suppliers and for their own end product as well. This motivation toward *continuous improvement* drives leading x-ray companies to increase their capabilities and find smaller contaminants at higher speeds. Lastly, new features continue to be added reducing the overall incidence of contaminated product and general quality concerns such as missing product, broken product or other packaging anomalies.

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