thermoscientific

Protecting your brand by detecting needles in fresh strawberries

In light of the recent scare of needles inside fresh produce it's important to understand this is a serious yet challenging issue to address.

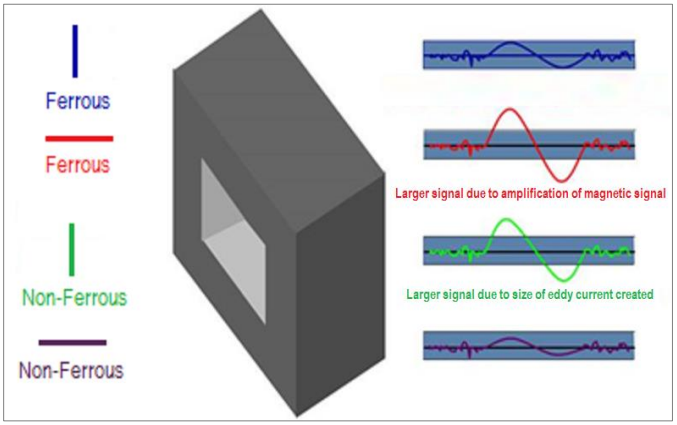
One of the challenges is determining at which location(s) in the supply chain - from the field to the checkout conveyor – that a needle can be inserted into a product. Many companies are, or should be, reevaluating their Hazard Analysis and Critical Control Points (HACCP) and Hazard Analysis and Risk-based Preventive Controls (HARPC) procedures. This unfortunate situation should have a positive impact on our business since MD and XR are preventive controls. Don't be surprised to see other counter measures being implemented to combat the situation. For example, tamper proof seals.

The second being what inspection system to use to ensure these needles are successfully detected and removed from the process. What should I use? Metal detector or x-ray inspection system? We recommend both.

As with all solutions, there are challenges with all metal detectors and x-ray inspection systems. In this case it's the size, shape, orientation, composition and density of the needle as it passes through the inspection system. Often these needles are extremely narrow and made of non-magnetic metals meaning their reactive signal will be very low in a metal detector. And in some cases the position of the needle/wire is such that it is not denser than the food product therefore it is not detected by an x-ray inspection system.

Metal detectors react to imbalances in the electromagnetic signal in the system. Not all metals react the same and products themselves have signals that have to be cancelled out. When metals pass through the detector the imbalance results in a detection. The industry uses spheres as standards because they are consistent while it's widely known that most foreign materials are slivers, wires and/or shard. These are more difficult to declare standards because their size, shape and composition vary.

The orientation of thin metal materials (wires & needles) as they pass through the metal detector head impacts the amount of signal. To the right are examples of ferrous and non-ferrous wires of the same size passing through a detector in different orientations, note the difference in signal magnitude.



X-ray inspection systems rely on density differences which can change drastically if a needle or wire is vertical or horizontal to the x-ray beam. There are also limitations to the size of the detection capabilities based on the diode size of the x-ray detector. Generally anything smaller than the diodes of the detector will not be detected because it won't cover enough of the diode. Most x-ray systems have 0.8mm diode detectors in them.

Michelle Schultz – PI Application Manager michelle.schultz@thermofisher.com October 3, 2018

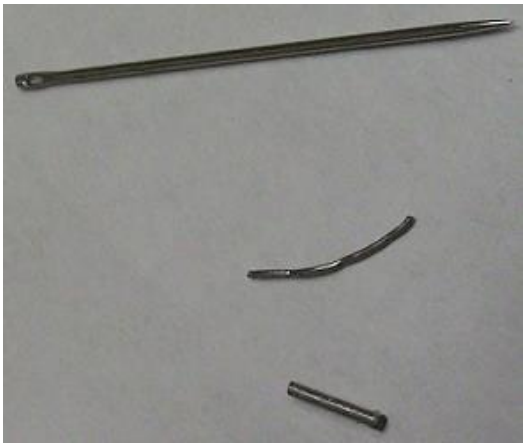
Product Inspection Application Bulletin

We recently conducted testing of strawberries packaged in a 16oz clam shell container using a NextGuard C330 (NG C330) X-ray inspection system and Sentinel5000 Multiscan Metal Detector. The X-ray inspection system outperformed the Metal Detector.

Understand this was a laboratory test to **provide application guidance only** and if a customer is interested in more detail they must send their products and "needles" to us for detailed testing.

Based on the testing, the standard size metal spheres were smaller and there was an improvement in the detection of the needles and wires. All foreign materials were tested in many orientations (vertically, horizontally in direction of flow, horizontally perpendicular to flow and at angles) to determine if the contaminant could be successfully detected.

The table below shows that a 0.63x5mm SST wire and 0.54x28mm sewing needle were detected in all orientations by the NG C330 x-ray inspection system, but the 0.42x9mm magnetic wire was only detected by the NG C330 in the vertical orientation, where the density is the greatest. This provides enough information to indicate that wires/needles must be at least 0.54mm in diameter and 5mm long in order to be detected by a typical X-ray machine.



In the Sentinel metal detector only the sewing needle was detected in all orientations, the 0.71x5mm SST wire was close to being detected when horizontal and perpendicular to the direction of flow because this presented the largest amount of metal in the electromagnetic field as it passed through the metal detector.

Test Results – Minimum contaminant level detected 100% on 10 passes each

Foreign Material	NextGuard C330 HP/SR	SENTINEL5000 350x150
FE sphere	1 mm	1.1 mm
NFE sphere	1 mm	1.5 mm
SST sphere	1 mm	2.5 mm
SST wire 	0.63x5 mm	0.71x5mm NOT DETECTED
Nickle plated sewing needle 	0.54x28 mm	0.54x28 mm
Magnetic metal wire 	0.42x9 mm (50% - only in vertical orientation)	0.42x9 mm NOT DETECTED

Michelle Schultz – PI Application Manager michelle.schultz@thermofisher.com October 3, 2018

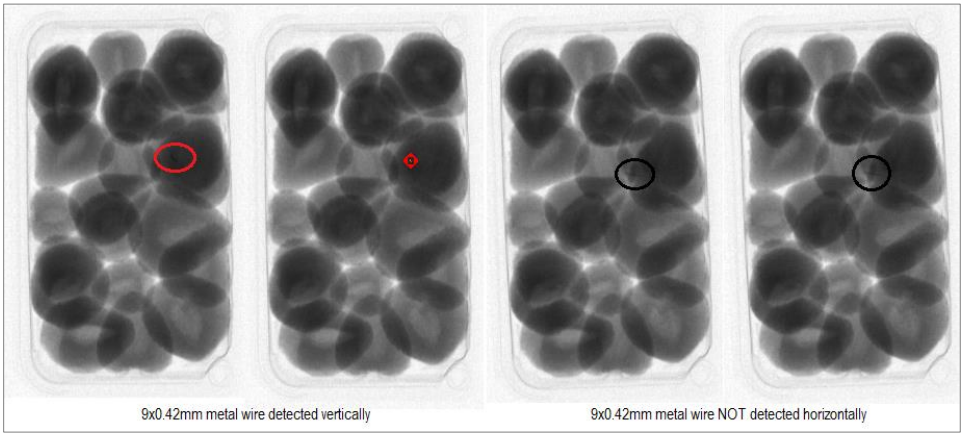
Test Settings – NextGuard C330 HP/SR

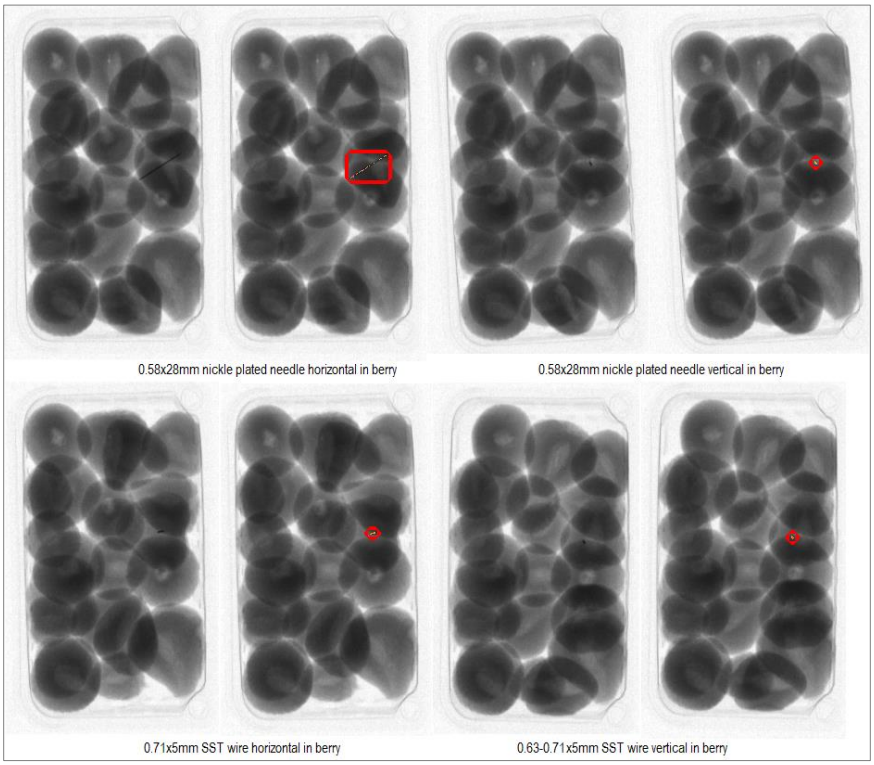
X-Ray		Scan Rate	Filters (Algorithms) Applied	Package Trigger		Conveyor Speed
Voltage (kV)	Current (mA)			Pre	Post	
60	2.525	1041.4	A1-A5, B1-B3, C1-C2	20mm		100FPM

Sentinel5000 350x150

Frequencies used	Phase Angles	Attenuation	Sensitivity thresholds		Product signals	
			In Phase	Out of Phase	In Phase	Out of Phase
300 kHz	198.6	0 dB	25.7	35.8	24-30	24-30
450 kHz	198.8		24.9	40.8		24-27
575 kHz	199		23.3	39.7		
725 kHz	231		22.5	40.9		
900 kHz	233		22.2	41.1		

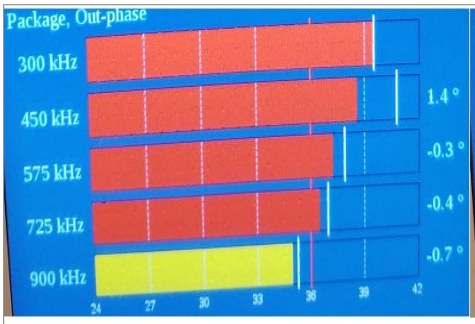
Test Images – NextGuard C330



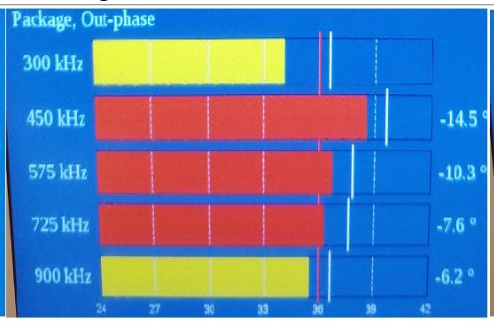


Screenshots from testing on Sentinel5000 350x150

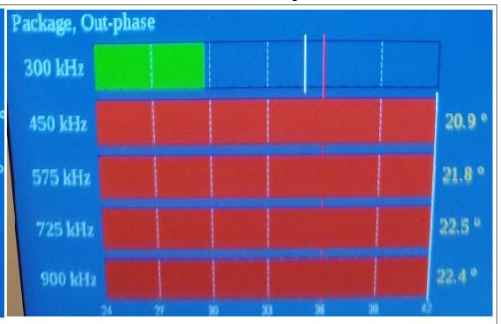
Red bars and/or white vertical lines to the right of the solid red vertical line indicate a detect & reject event



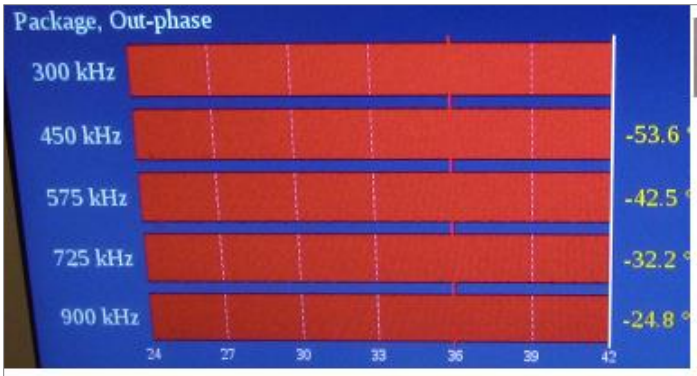
Detection of 1.2mm FE on 4 of the 5 frequencies



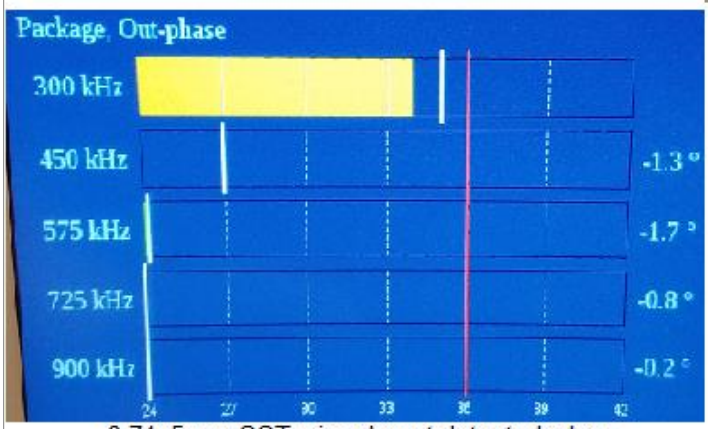
Detection of 1.5mm NFE on all 5 frequencies



Detection of 2.5mm SST on 4 of the 5 frequencies (2.25mm was NOT detected)



0.54x28 mm sewing needle detected in all orientations



0.71x5mm SST wire almost detected when passed perpendicular to flow

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