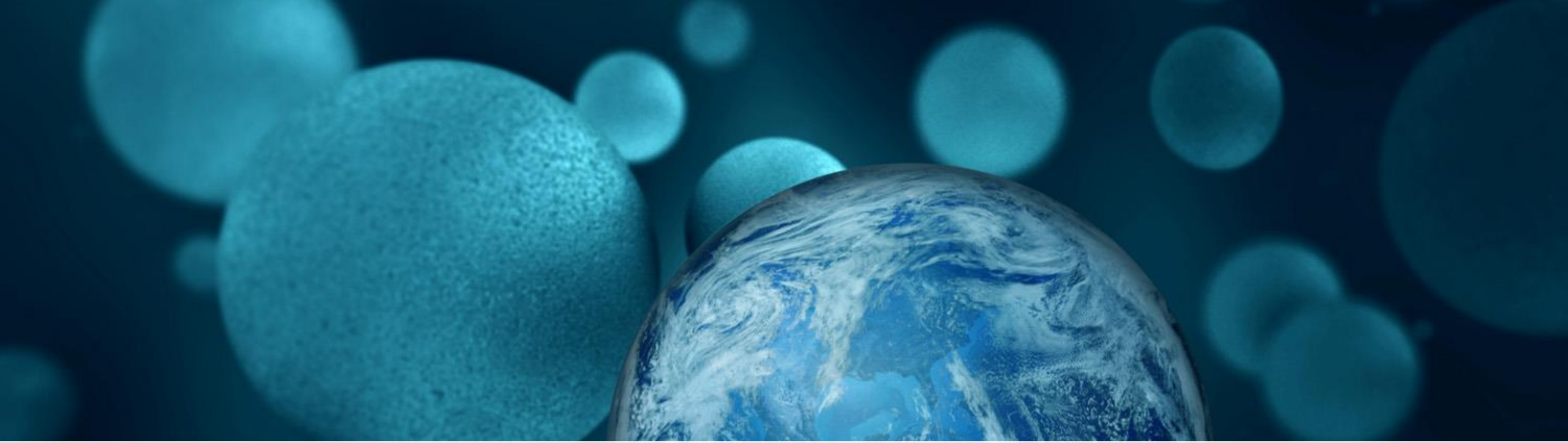

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How Multiscan Technology Will Revolutionize Metal Detection and Food Safety

Bob Ries
Lead Product Manager
Metal Detection and X-Ray Inspection

The Thermo Fisher Mission

Enabling our customers to make the world…

Healthier **Cleaner** **Safer**

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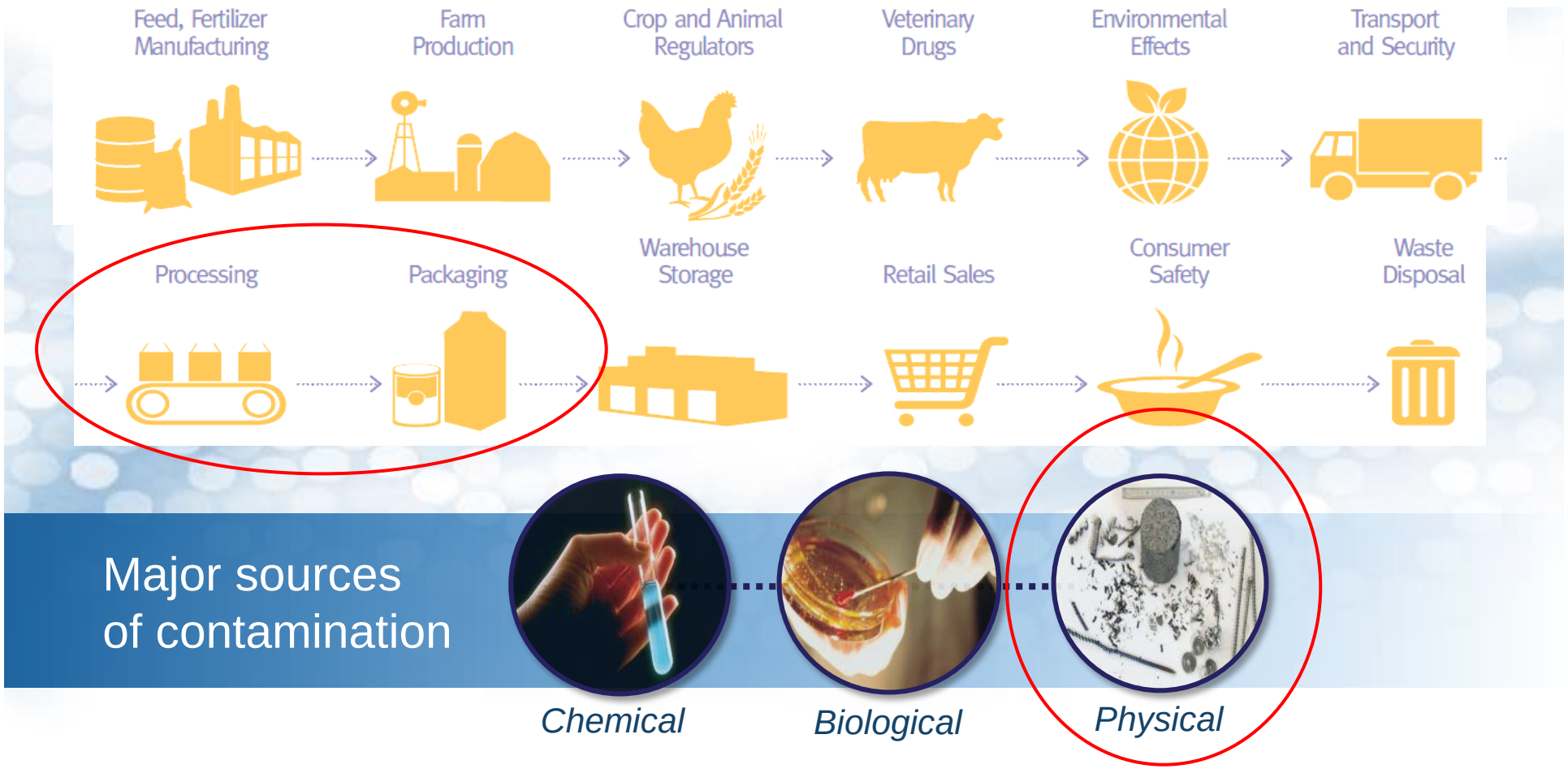
Contamination Threats to Food Supply Chain



Contamination threats exist in each step of the food chain

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On-Line Product Inspection Solutions

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Our History in Metal Detection

Analog detectors invented 65+ years ago by Goring Kerr (UK)

DSP1

Digital detectors entered in the 1990s

ADCs and digital signal processors

APEX

2006: Our fifth generation digital metal detector

20% sensitivity improvements

Intellitrack XR

Technology and customer-driven improvements

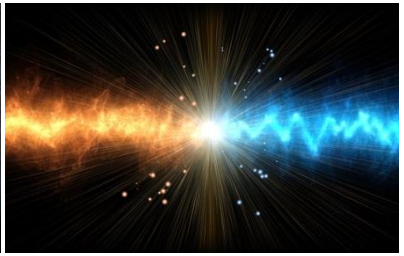
- Multiple transmit “coils”
- Multiple frequencies
- New product compensation techniques
- IP69K + ratings for thermal shock
- 300+ head sizes and styles for conveyors, gravity and pipe apps

>30,000 Thermo Scientific MDs in service today!

Metal Detection Market Drivers







Global Food Safety Standards	Codes of Practice	Reducing the Costs of Failure	Increased Expectations	Enhancements	Technology
FDA, HACCP, FSMA, GFSI, BRC… *Yearly changes in standards*	Retailer and producer demands *Not just detection:* • Fail-safe food safety • Protection/ reporting	• Rework • Scrap • Recalls *resulting in…* • Customer loss • Brand damage • Bankruptcy	Specs: 7 mm = “safe” *but* *customers want* < 2mm performance	• Easier to use • Better quality/ reliability • Service & support • Options • Flexibility…	Multi-frequency technology and signal processing software *Things that were impossible 5-10 years ago are now feasible*

Technical Backgrounder

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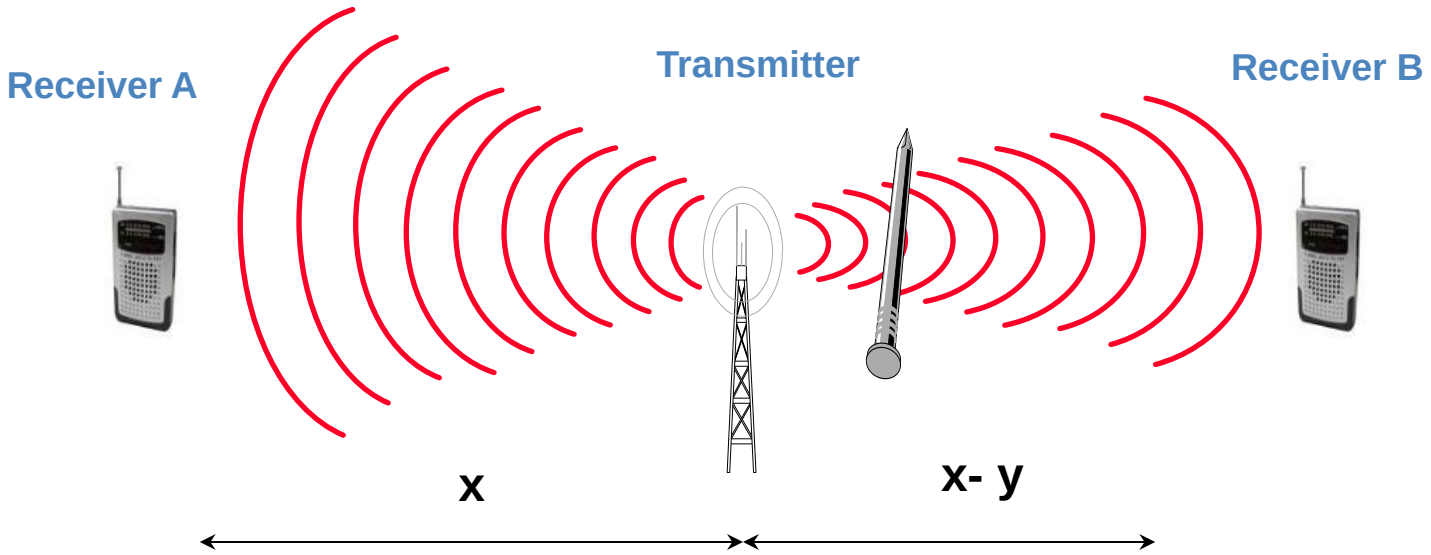
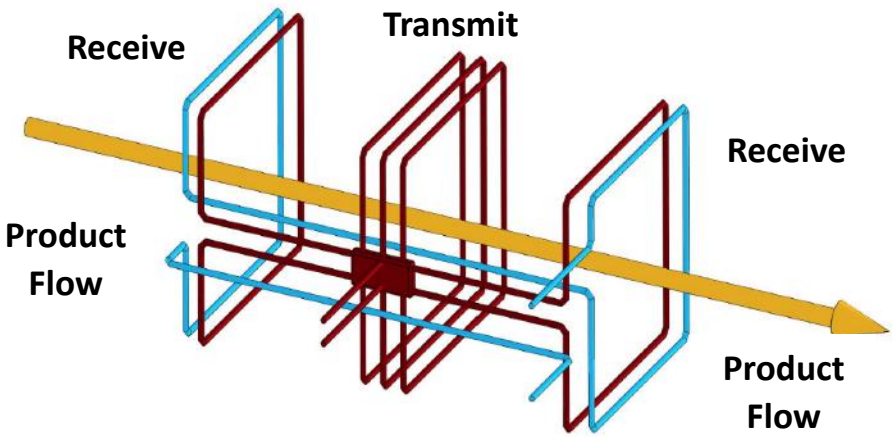
How Signals Are Generated in a Metal Detector

- **Balanced RF system used to detect small field differences**
- **Not actually antenna as drawn but loop coils around the aperture**
- **Thermo Fisher detectors use a proprietary multicoil design to boost receive signals**





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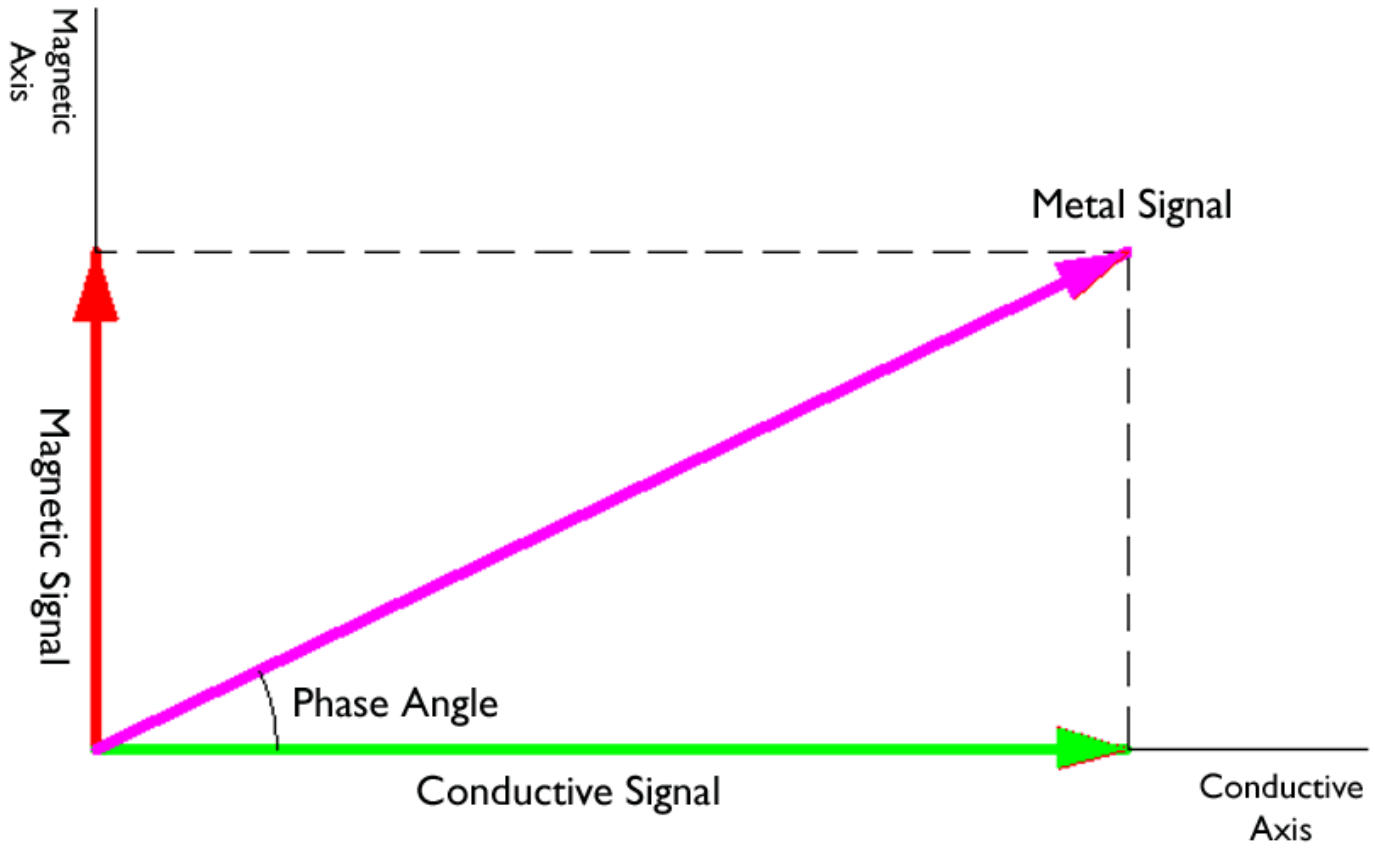
What is a Phase Angle?

- Two different signals are generated:
  - Magnetic
  - Conductive
- Various metals have different amounts of each signal
- The ratio of the two effects is referred to as the *phase angle*
- Most products with water, salt, minerals … also have phase angles
  - The product must be ignored (phased out) while the metal must be detected



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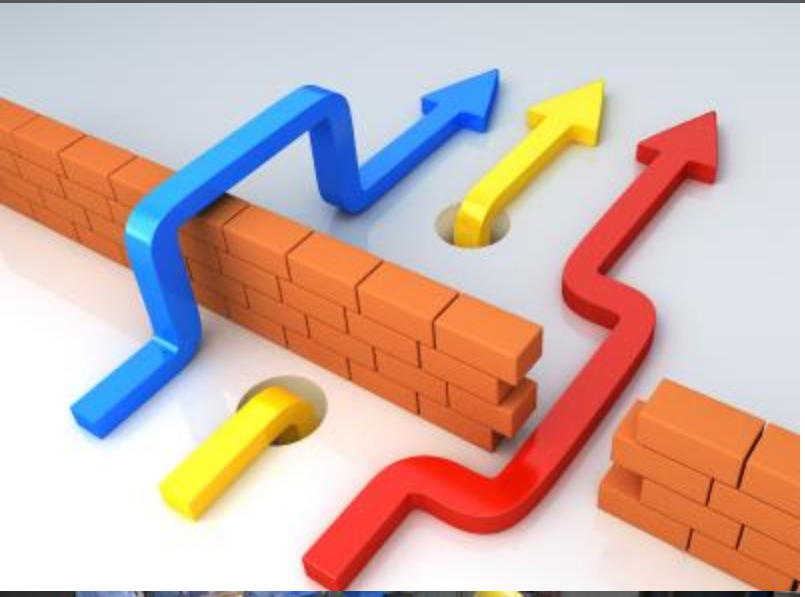
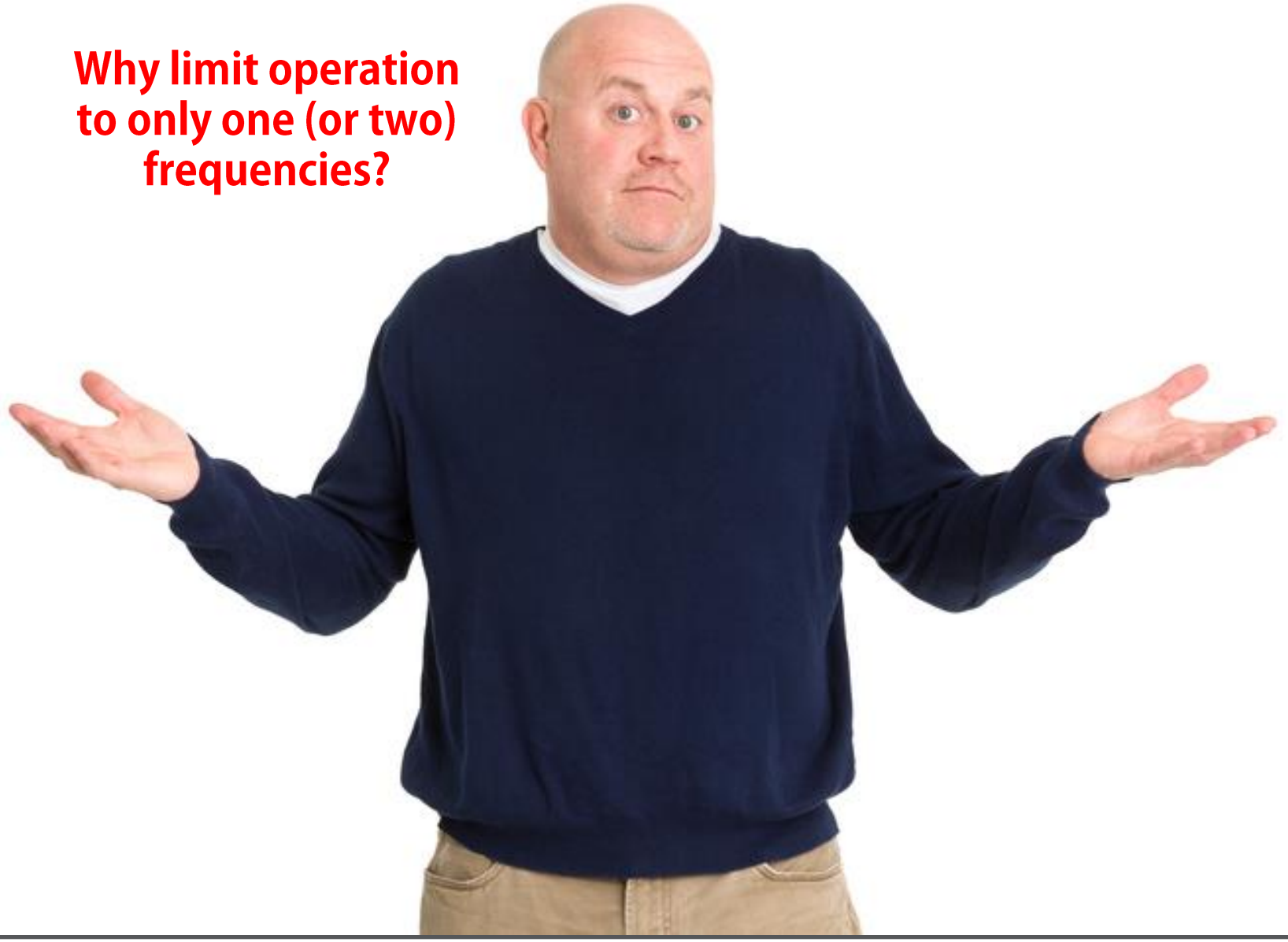
Three Things Make Metal Detection Difficult in the Real World



1. **Anything, anywhere in any product all the time**
   - Metal size, type, shape, position… Not spheres.
   - Dry, wet, mineral content, salt, layers …
2. **Product effects that look like metal in electromagnetic fields**
   - Finding contaminants in air is easy
   - Product compensation in hardware and software
3. **Small detection signals that are subject to many types of noise**
   - Motors/drives, dirty power, vibration, temperature changes, variation/drift…
   - Effects can come and go making problem determination more difficult

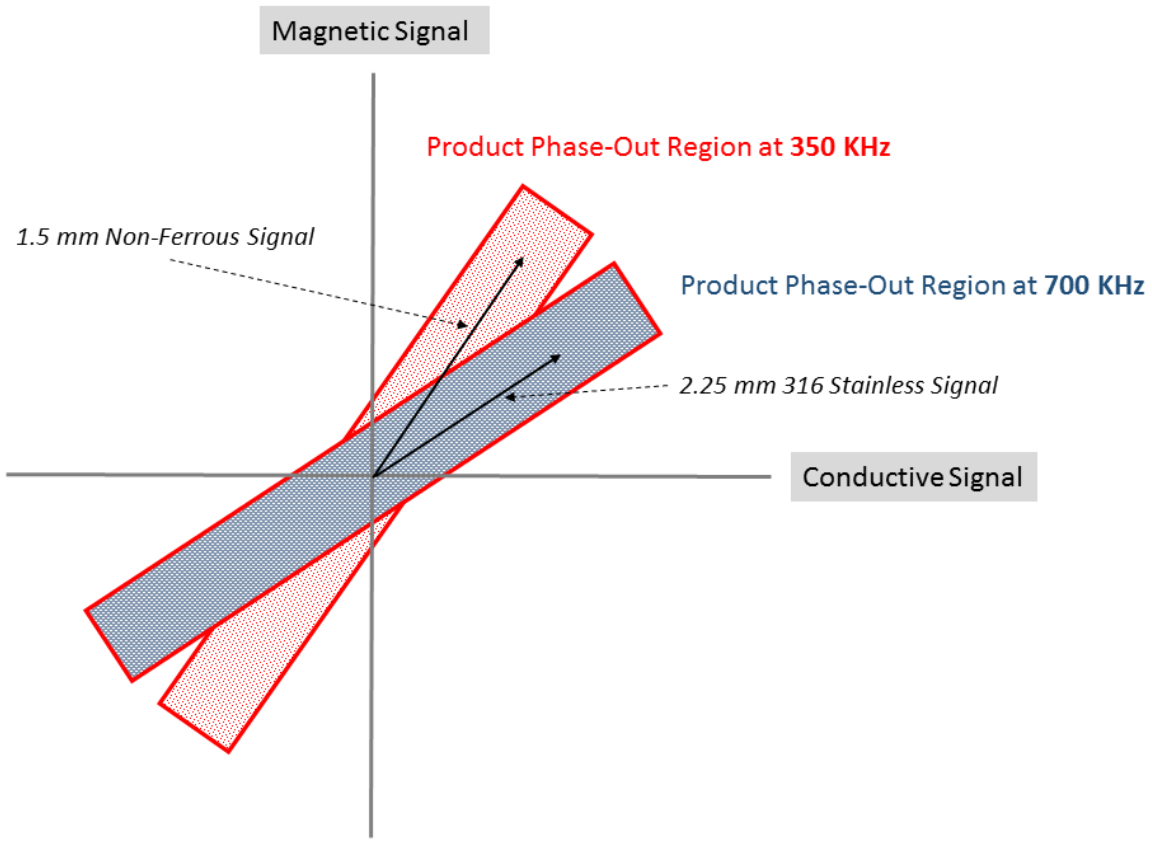
Why There Is No Best Frequency for Detection



- Varying reactions to magnetic and conductive properties
- False sense of security
- Impacts of size, shape, position, orientation

Phase Out the Product AND the Metal

- **Most products need compensation – phasing**
- **Metal can line up with the product phase and be missed**
- **Changing the frequency just moves this condition to another metal type**



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Introducing the Thermo Scientific™ Sentinel™ Multiscan Metal Detector

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A Completely New Approach to Metal Detection

The critical control point (CCP) scans up to five completely adjustable frequencies to find metal types and sizes previously undetectable.

Using a true broad spectrum approach reduces the probability of an escape by many orders of magnitude.

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A New Level of Food Safety

- 1, 2, 3, 4 or 5 frequencies at the same time (scanning)
  - From 50 to 1000 KHz
- Complete flexibility in what set of frequencies to use
- Per frequency adjustments
  - Gain, phase, sensitivity
  - Set-up automatically on 1-10 packs
- Frequently detects on various combinations of channels in the real world.

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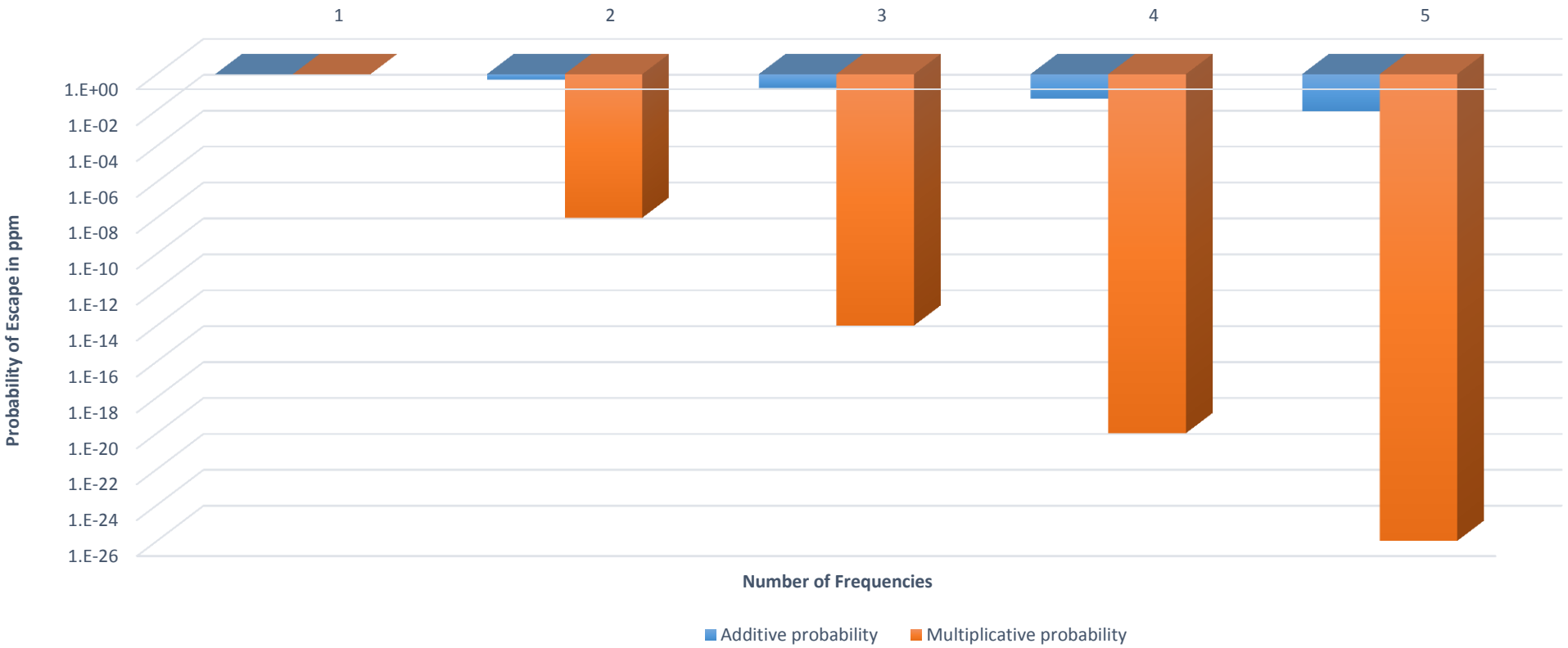
Probability of Detection with Multiscan

- Every detection system has a probability of an escape
  - Assume 1 out of 1 million packs = 1 ppm
  - At a pack/second, 16 hours a day, 5 days a week that is an escape about every 3-4 weeks!
- That escape could cost thousands to millions of $
- Escape factors:
  - Type of metal, shape, position, product effect…
- So what happens if you have five metal detectors back to back running the same package at different frequencies?

With Multiscan, Probability of Escape Decreases Exponentially!



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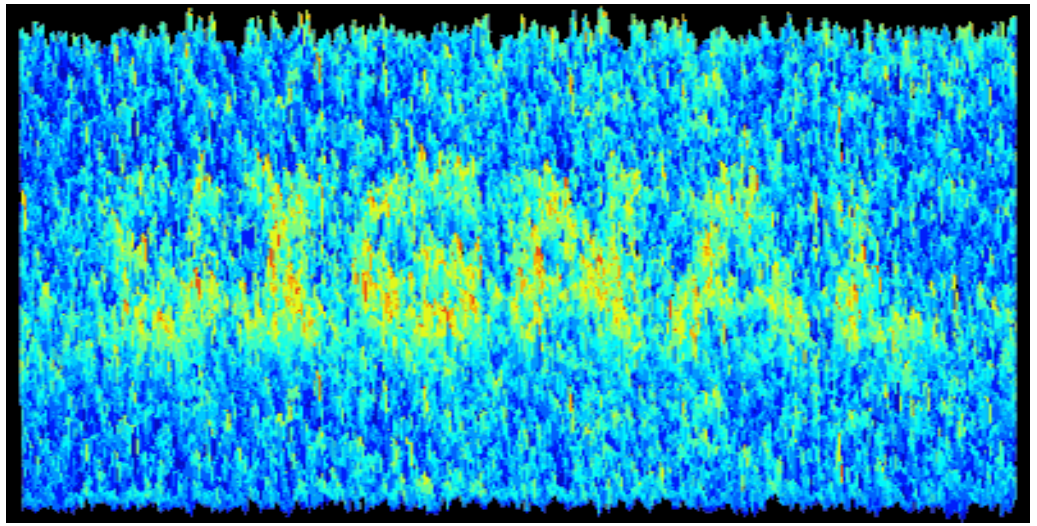
Noise Is Everywhere So Immunity Is Key

- **Electrical** – new power supply and built-in line filter
- **Electromagnetic** – completely shielded with software filtering too
- **Vibration** – solid fill and built in accelerometer to detect large physical shocks
- **Balance** – every frequency being used is electrically balanced
- **Conveyor system ground loops** – Thermo Fisher Quickfit and Customfit conveyors

If there is still noise at some frequency just adjust it or disable it!



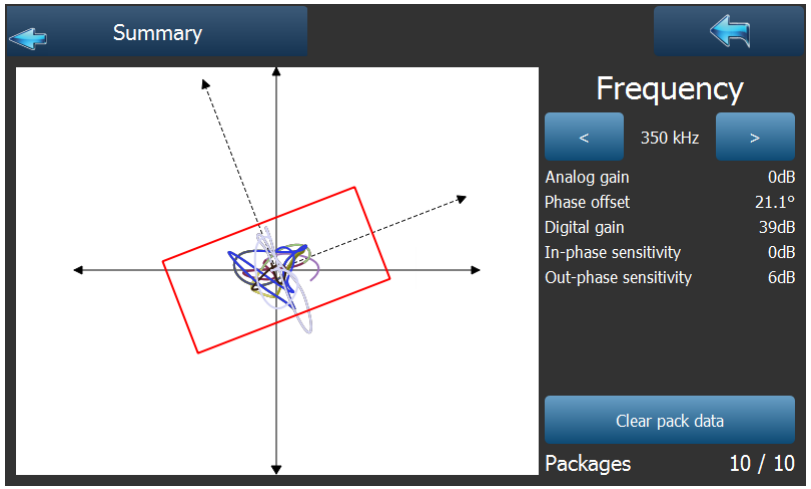
Multiscan Performance Improvements

	APEX 500			Sentinel 5000			Improvement	
	Fe	non-Fe	316 SS	Fe	non-Fe	316 SS	% Diameter	% Volume
On Air (No Product)	1.3	1.3	1.8	1	1.2	1.5	16%	41%
 Iron Fortified Cereal	1.3	1.3	1.7	1	1	1.3	23%	55%
 Shingled Sliced Cheese	1.4	1.9	3.6	1.1	1.6	2.4	26%	60%
 Wet Spinach	1.5	1.6	2.3	1.4	1.3	1.8	17%	42%
				Overall Average			20%	49%

NOTE: 500 X 200 mm (20 X 8 in) aperture size, Sphere diameter in mm

Other Important Benefits of Sentinel

- **Easy to use wizards** to learn products based on 1-10 packs
  - Simple to use, discloses all information, completely automatic or manual step by step
- **Reject report** to see what happened and why
  - Shows what frequency and parameter caused the rejection
  - Designed to tune out false rejections during initial installation
- **Color touchscreen** with optional polycarbonate cover
- **USB and Ethernet** built-in
- **IP69K tested**
- Options for **thermal shock** and **hot products** in the aperture



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Other Things to Consider to Improve Your Metal Detection Program

Look at the complete system, not just the metal detector head

- Photo eye registration
- Encoder to track belt speed and provide correct rejection
- Covered reject area
- Reject confirmation and bin full sensors - exit check sensor too
- Use password protection at all times
- Hourly auditing in the center of the aperture with product
- Phase tracking when needed
- Consistent product presentation if possible (guiderails)
- Lockable reject bins
- Regular preventative maintenance
- Operator training
- …The list goes on, think about all failure modes

So What About X-Ray?

Evaluate cost/benefit and then decide

- Price has decreased but is still 2-5X higher
- Machine complexity means more maintenance and shorter life
- Product effect is now density, finding small objects in big packs is difficult
- Speed and belt size limits
- Best for these applications
  - Metallized film or other metal in the package
  - Non-metallic contaminants
  - Desires for extremely small metal specs in products with high product effect

One Final Thought – How Do You Test Metal Detector Performance?

Product & foreign object position in the aperture

- Least sensitive position is exact center

Product and foreign object orientation in the aperture

- Wires have orientation effect

Position of contaminant in relation to the product

- Usually detection is the most difficult in the center

Metal detector set-up parameters

- Sensitivity vs false rejection, are the settings realistic?

Consistency of product (temperature, ingredients)

- Phasing can change, must have tracking in many cases

Position of the contaminant in relation to other contaminants

Package gap versus aperture length

- Is more than one product in the aperture at one time?

Test in as many different ways possible to assure reliability

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How to See Sentinel with Multiscan at Pack Expo Today

- Go to booth C-2200
  - Two live demos running
  - Other metal detectors on display too
- www.thermofisher.com/SentinelMD
- Talk to us about an in-factory “test drive”

thermoscientific

WHITE PAPER Metal Detection

Why Multiscanning Technology Improves Metal Detection and Food Safety

Bob Ries, Lead Product Manager,
Metal Detection and X-ray Inspection
Thermo Fisher Scientific

Introduction

Metal detectors are ubiquitous in food processing facilities. They are most commonly used at the end of the line and as the last line of defense to support food quality and safety before a packaged product is on its way to the consumer. The core technology has always had its limitations and compromises such as noise that can interfere with signals and product effect that can confuse a wet product with metal.

While metal detection technology has slowly evolved over the years, the challenges facing food processing have changed considerably. There are increasingly demands such as new regulations, retailer detection mandates and greater productivity demands. The stakes are higher too: the potential for a costly recall and collateral damage via social media.

No company is immune. Just visit www.fda.gov, and click on “recalls” to get an idea of the plethora of food safety problems reported every day.

Bear in mind that while some companies are transitioning to X-ray inspection to find foreign objects, it is not necessary in many applications due to the low risk of non-metallic contaminants and a cost that can be prohibitive for smaller producers.

Why Metal Detection is Not Easy

Why is it so hard to detect metals in food? A simple analogy may help: why does a coin or piece of jewelry set off a metal detector on your outbound flight but not your inbound flight? Why the inconsistencies?

The same unpredictable performance can exist when trying to detect metal in food. Metal detection is easy – when it works – but it doesn’t always work. Audits can fail, detectable metal types and sizes may not be what the quality manager wanted and, worse yet, a piece of metal may have escaped inside a product and a customer finds it.

Clearly, an on-again, off-again contaminant detection approach is not acceptable.

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Thank You

bob.ries@thermofisher.com

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