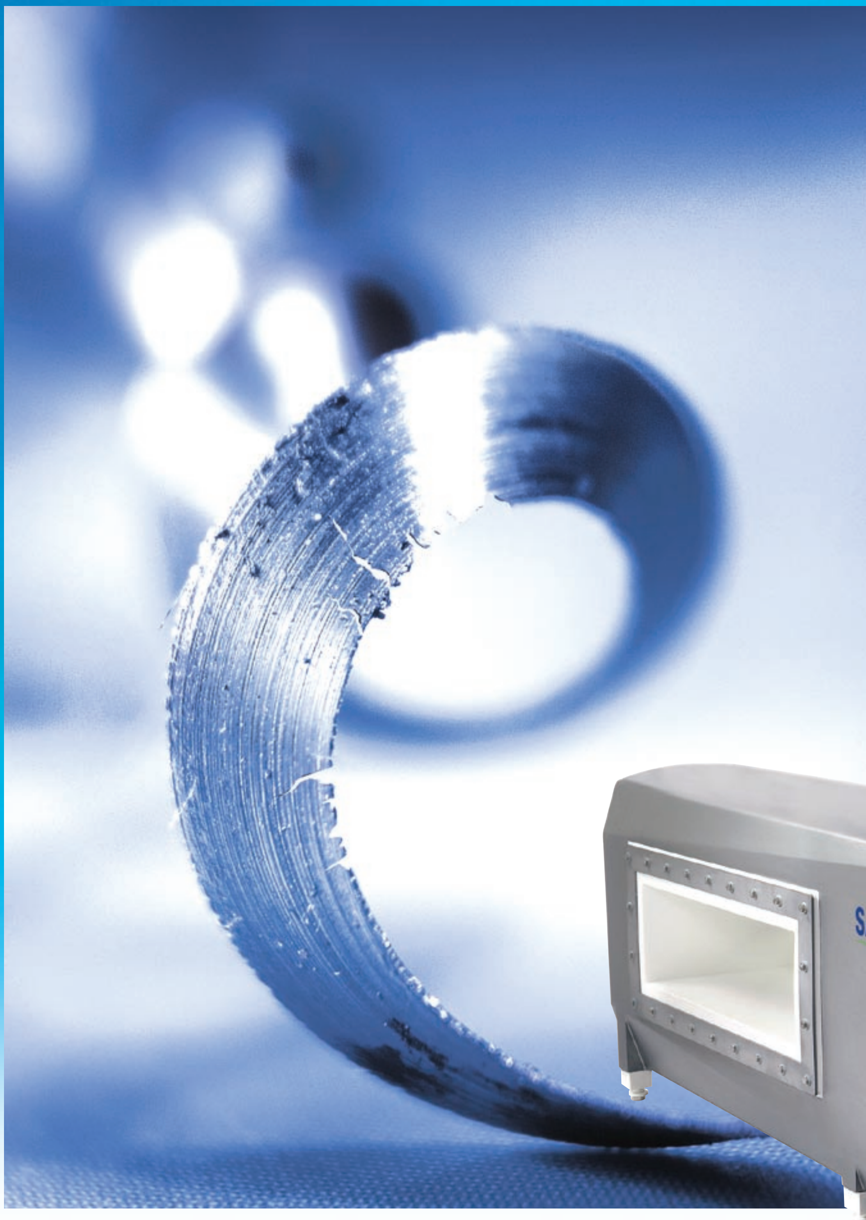
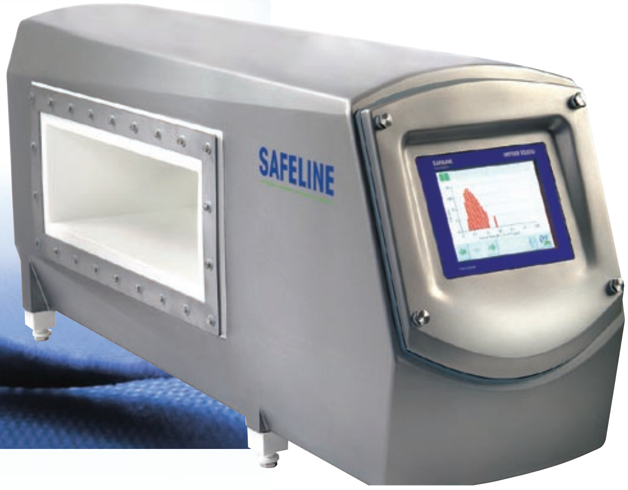
SAFELINE
Metal Detection

Metal Detection





Understanding Metal Contamination

- Shape of Metal
- Orientation Effect
- Improved Efficiency
- Increased Brand Protection

Detecting More Metal

For Increased Brand Protection

METTLER TOLEDO

Understanding
Metal Contamination

All metals fall into three main categories: ferrous, non-ferrous and stainless steel. The ease of detection will depend on their magnetic permeability (how easily they are magnetised) and their electrical conductivity (see Figure 1 below).

Metal Type	Magnetic Permeability	Electrical Conductivity	Ease of Detection
Ferrous (Chrome Steel)	Magnetic	Good Electrical Conductor	Easily Detected
Non-Ferrous (Aluminium, Brass, Lead, Copper)	Non-Magnetic	Generally Good or Excellent Conductors	Relatively Easily Detected
Stainless Steel (Various Grades) e.g. 304 / 316	Usually Non-Magnetic	Usually Poor Conductors	Relatively Difficult to Detect

Figure 1

Ferrous contamination is both magnetic and a good electrical conductor, and therefore is easily detected. Most metal detectors are able to detect small ferrous particles.

Non-ferrous metals such as aluminium, copper and lead, are non-magnetic but are good electrical conductors and are generally quite easy to detect.

Stainless steel comes in many different grades, some magnetic and some austenitic (totally non-magnetic); their conductivity varies depending on the grade.

In the food processing industry 304 and 316 are the two most common grades. Poor sensitivity to these grades can be a major limitation of many modern metal detectors, especially those not capable of operating at high frequency. When inspecting wet, electrically conductive products, the problem of detecting stainless steel becomes even more acute.

A good indication of a metal detector's all round capability is the sensitivity ratio between ferrous and the most difficult to detect grades of stainless steel. This ratio can be as good as 1:1.5 and as poor as 1:2.5. This has a major effect on the detector's ability to detect real-life practical contamination such as swarf, slivers of metal and screen/sieve wire, all of which exhibit something that is known as an orientation effect.

Shape of Metal
Metal spheres are used as a standard to determine detector capabilities. There are two reasons for this.

- Spheres are available in a wide range of metals and diameters
- A sphere has a constant shape which ever way it is presented to the detector, i.e. it has no orientation effect.

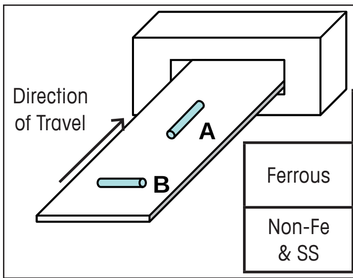
The sensitivity of a detector is usually defined as the diameter of a metal sphere of a specific metal which is just detectable in the centre of the aperture.

Orientation Effect

This effect is noticeable on all non spherical samples such as wire, slivers of metal and swarf, but it is most pronounced on wire and pins. If the wire diameter is greater than the spherical sensitivity of the detector, an orientation effect is not observed, and even very small pieces will be found.

If, however, the wire diameter is less than the spherical sensitivity, the ease of detection will depend on its length and 'orientation' as it passes through the detector.

Figure 2 below shows that a piece of ferrous wire is in the most difficult orientation to detect when it is at 90° to the direction of flow, and the easiest when aligned along the conveyor belt and the direction of travel. Non-ferrous and stainless steel wires are just the reverse. If this type of contamination is likely, care should be taken to ensure the detector is, in fact, capable of detecting it.



	A	B
Ferrous	Easy	Difficult
Non-Fe & SS	Difficult	Easy

Figure 2

Optimum Performance

The simplest and most effective way to overcome orientation effect is to operate the metal detector at the highest achievable sensitivity level possible. If, for example, the detector is set to detect a 1.5mm diameter ball bearing only wires with a diameter less than 1.5mm will exhibit an orientation effect. If the sensitivity is increased to 1.0mm, only wires with a diameter of less than 1.0mm will exhibit an orientation effect and potentially pass undetected.

Clearly, to minimise the orientation effect, it is preferable to operate the system at the highest and most reliable level of sensitivity. Therefore, detailed consideration must be given to: where best to install the metal detector, the frequency of the metal detector, and the size of aperture to be used.

Overcoming Orientation Effect

One possible solution to overcome the orientation effect is to use a double or triple headed metal detection system, as shown in Figure 3 below.

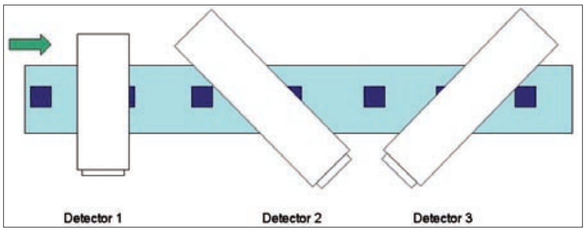


Figure 3

Inspecting products using metal detectors set at different angles to the conveyor changes the position of the contaminant relative to the detector. As a result, the contaminant is guaranteed not to pass through the entire system in its worst orientation and the chances of detection are significantly improved.

It is vitally important when employing a 2- or 3-headed metal detection system that the spherical operating sensitivity is not compromised relative to a single-headed system. A reduction in the spherical sensitivity standard would negate the improvement gained from utilising angled metal detectors and actually reduce, not increase, detection levels.

Increased Brand Protection & System Uptime

One of the largest "costs" incurred by food producers is that associated with the downtime of vital processing and packaging equipment. Metal detectors frequently fall into this "vital" category as they are often cited as a critical control point (CCP) as part of the hazard analysis under a HACCP programme. The use of a multiple head system will increase the amount of metal detected, providing greater brand protection and virtually guaranteeing 100% system uptime. This is because the chances of more than one of the metal detectors encountering a technical problem at the same time (which would result in a line stoppage) is statistically very unlikely.

Profile Technology versus Conventional Metal Detection Technology

	Metal Detector Type & Spherical Sensitivity (Ferrous)		
Contaminant Type & Size	**Conventional** Technology @ **1.0mm** Diameter Ferrous Sphere	**SAFELINE Profile** Technology @ **1.0mm** Diameter Ferrous Sphere	**SAFELINE Profile** Technology @ **0.8mm** Diameter Ferrous Sphere
Ferrous Metal 0.8mm Diameter Sphere	✗ **No**	✗ **No**	✓ **Yes**
Ferrous Metal 1.0mm Diameter Sphere	✓ **Yes**	✓ **Yes**	✓ **Yes**
Stainless Steel (316) Wire 0.5mm diameter 50mm long 	✓ **Yes**	✓ **Yes**	✓ **Yes**
Stainless Steel (316) Wire 0.5mm diameter 25mm long 	✗ **No**	✓ **Yes**	✓ **Yes**
Stainless Steel (316) Wire 0.5mm diameter 10mm long 	✗ **No**	✗ **No**	✓ **Yes**

www.mt.com/metaldetection

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