Minebea intec
The true measure

Always a wavelength ahead of foreign objects.

How to select the right metal detection technology as a food manufacturer.

What is the first thing that comes to mind when you think of metal detection? Airport checks? Treasure hunting? These are definitely interesting applications but metal detectors are actually extensively used in the food industry. In particular, they are used to protect consumers from products contaminated with metal.

Minebea Intec offers a wide range of metal detectors and has created an innovative solution with the metal detector Mitus®, which is based on flexible MiWave modulation.

When foreign objects become a foreign concept.

This guide explains the basics of metal detection technology, describes how the MiWave technology works and lists its benefits. Finally, we will show you our product finder, which you can use to easily find the optimum products for your requirements.

We hope you find the guide informative!

Welcome!

You can expect helpful answers to other important questions:

- How much does a product recall cost?
- What type of foreign objects does metal detection find?
- What factors influence detection results?
- What are the limits of metal detection?

Why metal detection?

There are numerous metal detection applications in the food industry that are used to protect consumers. The aim is to ensure that products leaving the factory are free from metal contamination. Metal detectors from Minebea Intec therefore support compliance with industry regulations such as HACCP, IFS and BRC. They protect your brand image and avoid costly product recalls.

Product quality is the top priority

Manufacturers in the food industry who decide to use metal detection benefit in various ways. First and foremost comes safeguarding product quality and therefore protecting consumers. Contaminated products may result in expensive recall campaigns and, in the age of digital consumer networks, may damage your brand. The phase in which metal detection is used is crucial for the success of this inspection mechanism in the food sector. For example, if metal detection is used upstream of cutters or grinders then expensive repairs may be prevented and foreign objects will not be crushed or multiplied. Another metal detector ahead of the packaging line ensures a final inspection of the products that will encompass metal parts that may have been introduced by the production process.

A metal detector can detect foreign objects made of various materials. It is not possible to make a blanket statement about the size of foreign objects that can be detected. This will depend, among other things, on the material of the foreign object, the properties of the product (see product effect on page 7) and other variables.

What foreign objects are detected?

In principle, the metal detector detects foreign objects made of metal. This includes ferrous metals, non-ferrous metals and non-magnetic stainless steel.

- **Ferromagnetic metals (Fe)**
  All metals that are easily attracted by a magnet (e.g. steel). Ferrous metal is the easiest metal to detect.

- **Non-ferromagnetic metals (NonFe)**
  Non-magnetic metals with a high conductivity (e.g. aluminium). Due to their conductivity, these metals generate a similar signal to ferrous metals in dry products.

- **Non-magnetic stainless steel (SS)**
  High-quality stainless steels from the AISI 300 series (e.g. AISI 304). Due to their low conductivity and permeability, these metals are relatively hard to detect.

In order for detection to be successful, neither the immediate surroundings nor the product packaging itself must contain metallic objects that are taken through or pass by the search coil. A screw-top jar with aluminium seal, for example, will make it harder to detect metallic foreign objects reliably. An X-ray inspection system would be the right inspection method to use for this application.

How much does a product recall cost?

Allianz Global Corporate & Specialty has previously conducted an assessment of product recalls. Alongside unlisted allergens and incorrect information, foreign object contaminations are a prime concern. In the event of extensive product recalls, i.e. when the product has reached international retail, the losses amount to an average of eight million euros. In addition to the risk of **image damage** with **consumers**, there is also a risk of image damage with **trading partners**. A product recall may have a negative effect on **delivery reliability** and therefore on the business relationship.

How does a metal detector work?

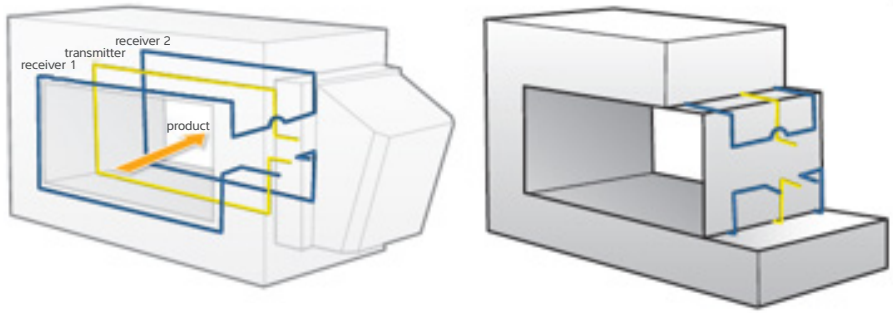
Metal detectors have a tunnel-shaped or round opening, through which the product passes horizontally or vertically. The wide range of models is important, because the outlet opening and the products must match each other.

Detection based on an electromagnetic field

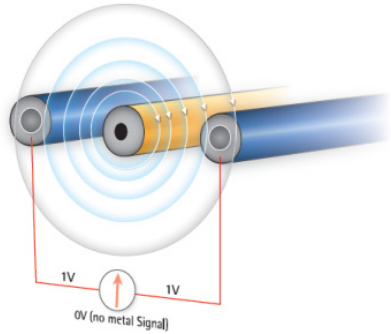
Irrespective of the model or area of application, the technology of a metal detector is based on changes in an electromagnetic field. In order to make this possible, the detector contains search and receiver coils, which are usually made of copper and are arranged around the detector channel. When viewed simply, the metal detector is based on three coils. The middle coil is what is known as the transmitter coil. It emits a high-frequency alternating electromagnetic field. The two outer coils are the receiver coils. The receiver coils are arranged in the opposing direction. Depending on the housing dimensions, the evaluation electronics and operator terminal (HMI) connected to the transmitter and receiver coil are either integrated into the housing or provided in a separate terminal.

The way a metal detector works

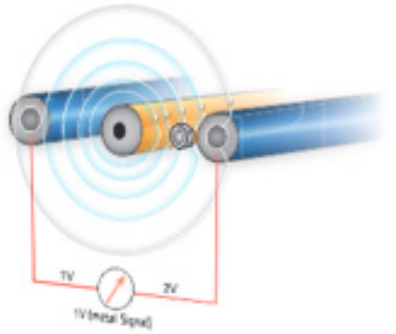
In order for optimum analysis to be carried out, the signals of both receiver coils must be perfectly balanced with each other. In addition to an unaltered spacing of the coils, the crucial factors also include the detector channel and the evaluation electronics. The inductive coupling of the three search coils forms the basis for metal detection. The two receiver coils are electrically wired together so that voltages induced by the transmitter are cancelled out. If an object is fed through the search tunnel, this changes the magnetic field and causes a voltage difference. This change will vary in size depending on the electrical and magnetic conductivity of the object. Due to their properties, metallic materials are particularly easy to detect using this principle.



Horizontal metal detection with search and receiver coils



In a perfectly balanced search coil, the voltage is 0 volts



Grouping of the magnetic field lines

Consolidate your metal detection knowledge

Requirements, technology and application recommendations: increase your expertise in foreign body detection by downloading our White Paper.

White Paper
Foreign body detection

What is the product effect?

As mentioned in the introduction, the physical principle of the metal detector is ideally suited to detecting metallic foreign objects. However, all materials, including the inspected product, have specific electrical and magnetic conductivity properties. The impact of these properties is referred to as the product effect. Depending on the properties of the product, this may be negligibly small to significantly large, which in turn has an impact on the detection sensitivity that can be achieved.

Product effects result in interference with the magnetic field

Metals are not the only materials that are capable of being conductive and therefore generating magnetic fields. Salt water, for example, is also a very good conductor with a very low permeability in comparison with metal. As soon as salt water is exposed to an electromagnetic field, eddy currents generate a magnetic field. If the product effect generated by the product is big enough to cause a similar magnetic field interference as a potential contamination, the detection result will become inaccurate.

Definitions

Permeability:
Penetrability of a material for certain substances (e.g. that of the ground for water).

Conductivity:
Conductivity is a variable used in physics. It describes how well a certain material conducts electric current.

The graphic provided here helps to estimate the product effect.

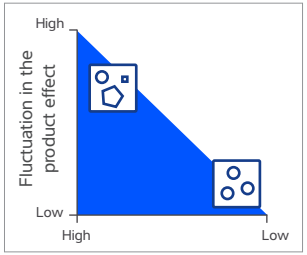
Expected product effect: low	Expected product effect: moderate	Expected product effect: high
Dry pasta, grains, chocolate, biscuits, sugar, sweets, spices	Dried fruit, yoghurt, hard cheese, oils, jam, ice cream, processed fish and meat products (fish fingers, BiFi, etc.)	Meat, fish, cream cheese or cheese in brine, sauces
		
In principle it can be assumed that dry, solid products have a low electrical conductivity.	Processed foods with a low moisture content usually have moderate electrical conductivity.	Fresh products often contain chemical compounds that are electrically conductive.

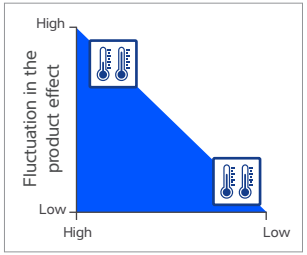
Fluctuating product effects

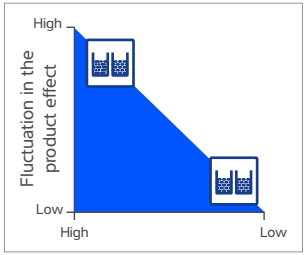
It is not only large product effects that have a negative impact on the detection sensitivity, the same is also true of fluctuating product effects. These fluctuations may have various causes.

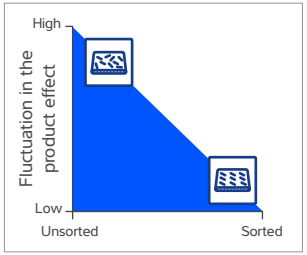
Four significant criteria are stated here:

- Product complexity: Products occur in various shapes and sizes
- Temperature fluctuations: Product temperatures change, critical for particularly hot or frozen products
- Product homogeneity: Product recipe or composition is subject to change
- Position and orientation in the line: Arrangement of the product in the line is not fixed









In principle, a significant variation in these factors will also result in a greater fluctuation in the product effect. In the case of temperature fluctuations, additional effects such as thawing processes or changes in moisture will also have an influence.

How do you choose the right technology?

Correctly understanding the application and the task are key selection criteria.

In order to choose the right metal detector, you first need to clarify what environment the device will be situated in. For example, if it will be subjected to frequent and intensive cleaning processes then it makes sense to choose an appropriately high IP protection class. Or are there flammable substances in the surroundings? Then the metal detector should have ATEX certification, i.e. it must have an explosion protection class.

Check list: Three steps to getting the right technology

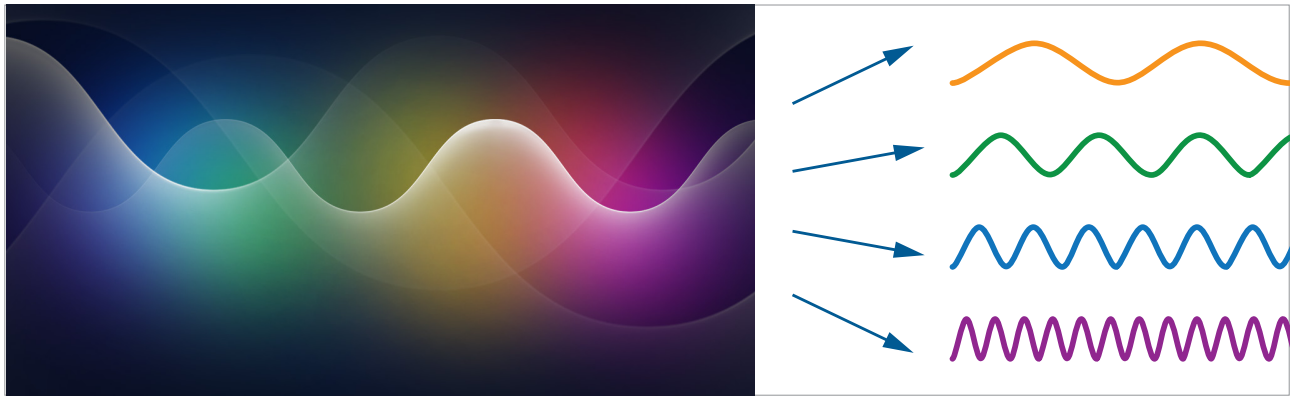
- ✓ Ambient conditions for the metal detector identified
- ✓ Channel opening determined based on the product sizes
- ✓ Properties of the products checked

Reduce separation errors with MiWave modulation

Once you have investigated the conditions of the environment in which the metal detector will be used, consider the product sizes and, accordingly, determine the channel openings. The rule here is that the smaller the ratio of the product size to the channel opening, the higher the levels of sensitivity that can be achieved. A ratio of around 70 per cent is ideal.

In the previous section about the product effect, we showed that not all products are created equal. The different properties, such as conductivity, create different requirements for signal generation, processing and evaluation. In this area, Minebea Intec is bringing in the innovative flexible MiWave modulation technology. This is a procedure that modulates the transmission signal for a number of frequencies, then separates them and evaluates them separately using an intelligent algorithm.

As a result of this division into several signals, the products can be symbolically inspected from several perspectives. This significantly increased information content means that high search sensitivities can be achieved in spite of large product effects. In addition, this technology is less susceptible to fluctuating product effects such as temperature changes or thawing processes.

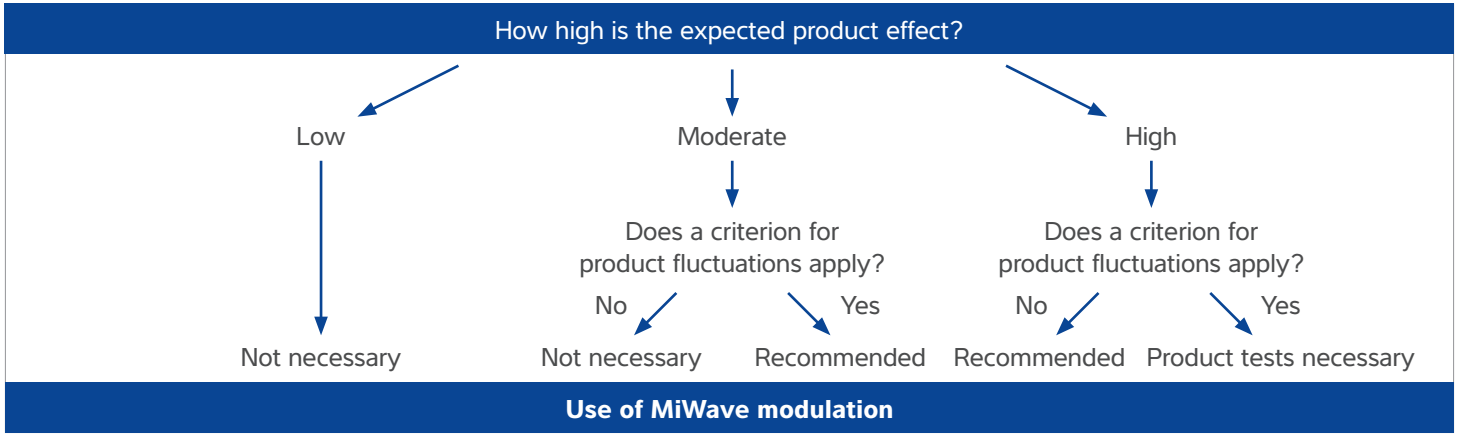


Using pulse width modulation, the MiWave technology from Minebea Intec generates a complex signal, which can be split.

Find out more about MiWave modulation in our Mitus® product video.

Watch now!

Use the decision-making tree below to check whether using MiWave technology would make sense for you.



If you are looking for a metal detector for applications in the food industry and have decided to use MiWave technology, then our metal detector Mitus® is perfect for you. If your application does not require the use of MiWave technology, we recommend our metal detector Vistus®.

Metal detection system Mitus®
Reliable inspection for challenging applications

- Maximum detection sensitivity for foreign objects in production lines in the food industry
- Real multi-frequency system tolerates fluctuations in product effects
- Very easy to use, optimum connectivity and various design options
- Durable, robust design

Metal detection system Vistus®
Reliable inspection for popular applications

- High detection sensitivity for foreign objects in production lines in the food industry
- Wide frequency range for the ultimate in detection performance
- Very easy to use, optimum connectivity and various design options
- Durable, robust design

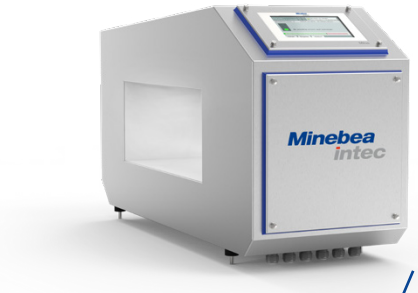
Best Practice: Highly precise metal detection for salad dressings: MiWave technology reduces separation errors

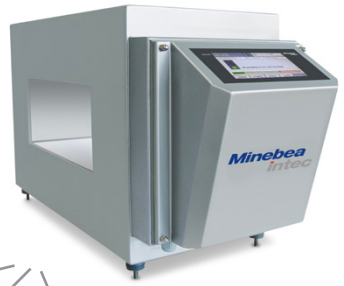
Products with high conductivity are very challenging for today´s metal detectors and considerably reduce the detection sensitivities that can be achieved. This is true at a German company that produces, among other things, salad dressings for the wholesale trade. In order to reduce rejection errors and therefore increase productivity, the company has converted to the metal detector Mitus® with flexible MiWave modulation.

To best practice

Minebea Intec metal detectors are available in three models

No matter whether you have decided on the metal detectors Mitus® or Vistus®, both solutions can be integrated one-to-one into our detection belt, freefall or pipeline systems.





Our metal detector belt solutions for packaged products

Freefall is the top choice for metal detection solutions for powder or granulate foods.

The pipeline detects and removes metallic contaminations in pumped viscous or liquid products.

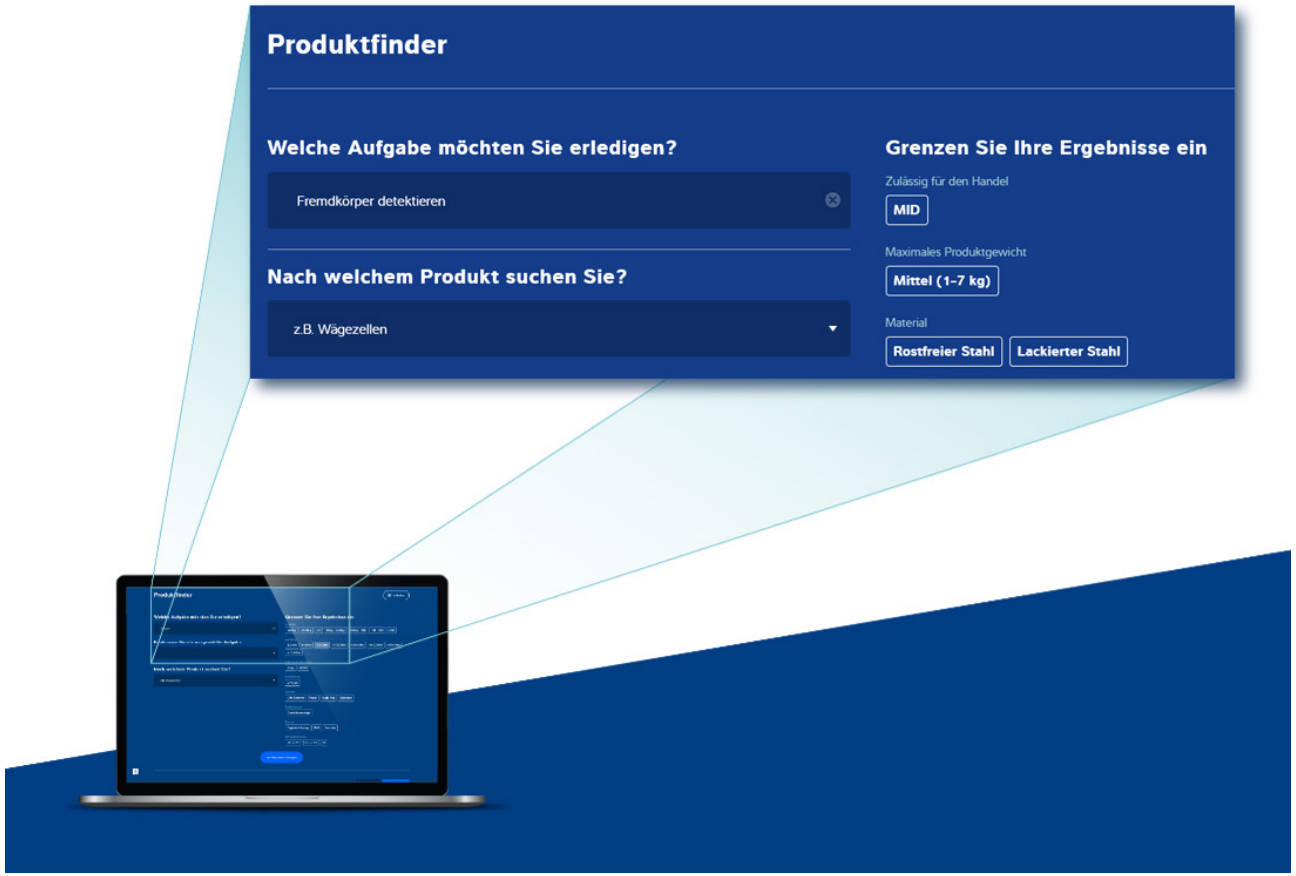
When should you use X-ray inspection systems?

If, alongside unwanted metallic objects, you also want to detect and expel foreign objects made of glass, stone, minerals or even some types of plastic, then it is advisable to use Minebea Intec X-ray inspection systems. In addition to detecting foreign objects, these systems can also perform integrity testing and product weight calculations.

White Paper X-ray inspection

Are you already familiar with our product finder?

In addition to smart inspection technologies for foreign body detection, the extensive Minebea Intec product range also includes high-quality weighing systems and corresponding software products. The product finder has been created to ensure that you can narrow down the wide variety of products in the individual segments to pinpoint the perfect solution quickly and reliably. Three clicks are all you need for the tool to show you all the possible options. It is intended to make it as easy as possible for people looking for solutions to get started. It is therefore possible, for example, to start the selection according to applications such as foreign body detection, weighing or counting. The user can then narrow the selection down further by selecting the type of product required, which results in products that are direct matches being displayed. The hits can be further narrowed down using the large number of filter options, such as certificates, capacities or accuracy classes.



Give our intuitive product finder a try now!

To the product finder

Everything from a single source

Minebea Intec provides products, solutions and services to improve the reliability, safety and efficiency of production and packaging lines in the industry. From goods receipt to goods issue – our portfolio comprises a variety of automatic and manual weighing and inspection solutions, software and services for a wide range of applications and industries.

Process weighing and automation

- Vessel and silo scales
- Components for truck scales
- Bench and floor scales
- Batching and formulation

Quality assurance

- Checkweighers
- Metal detectors
- X-ray inspection systems
- Vision inspection systems
- Weigh price labelling systems
- Statistical process control

Services

- Technical support
- Commissioning
- Maintenance and repair
- Upgrades
- Training courses

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