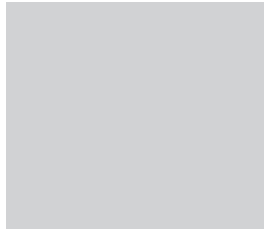


Guide to Metal Detection



Loma Systems offers this guide to metal detection to assist food and packaging companies in establishing an effective metal detection program that meets regulatory guidelines

EXECUTIVE SUMMARY

The progress of technology has taken metal detectors from valves to transistors, to integrated circuits and more recently, into microprocessors. Naturally this has increased their performance giving greater sensitivity, stability and flexibility, as well as widening the range of output signals and information they provide.

Loma Systems is the world's leading engineering and manufacturing company specializing in metal detection, checkweighing and x-ray inspection systems.

We have over 120,000 metal detection systems installed worldwide and are known for having the premier detection technology on the market today due to our true variable frequency technology.

How a Metal Detector Works

The most widely-used type of metal detector in the food industry functions on the principle known as the 'balanced coil' system. This type of system was registered as a patent in the 19th century, but the first industrial metal detector was not produced until 1948.

The progress of technology has taken metal detectors from valves to transistors, to integrated circuits and more recently, into microprocessors. Naturally, this has increased their performance providing greater sensitivity, stability and flexibility, as well as widening the range of output signals and information they are able to provide.

All the same, modern metal detectors are still unable to detect every particle of metal passing through their aperture. The physical laws applied in the technology limit the absolute capability of the system. Consequently, as with any measuring system, metal detectors have restrictions on accuracy. These restrictions vary depending on the application, but the main criteria is the size of the detectable metal particle. However, despite this, metal detectors perform a valuable and essential role in process quality control.



Two Main Categories for General and Foil-Wrapped Products

Modern metal detectors fall into two main categories. The first category consists of systems with a general purpose search head. These systems are capable of detecting ferrous and non-ferrous metals as well as stainless steels, in fresh and frozen products - either unwrapped or wrapped, even in metallized films. The second main category consists of systems which have a ferrous-in foil search head. These are capable of detecting ferrous metals within fresh or frozen products which are packed in foil wrapping.



Guide to Metal Detection

For optimum inspection performance, it is recommended that you select a metal detection system which has been designed specifically for your unique user and application needs. The ratio of the aperture size to the product size is important for maximizing inspection performance.



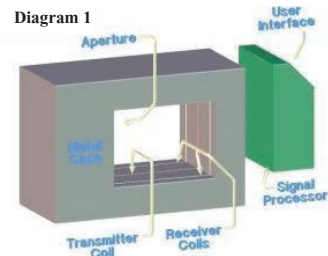
Companies rely on the speed and efficiency of the Loma Systems IQ3 metal detector as part of their quality control program.

The 'Balanced Coil' System: How it Works

All general purpose metal detectors work essentially in the same way, although for optimum performance you should select a metal detector which has been designed specifically for your application. Construction techniques ensure that independent mechanical movement of the search head's components, and the ingress of water and dirt, are prevented.

For optimum performance you should select a metal detector which has been designed specifically for your application. As you will see in *diagram 1*, the typical detector is encased in a metal box. This houses the coil components and provides a shield to protect them. The aperture, the tunnel through which the products pass, is lined with a non-metallic material (usually plastic), which provides a hygienic environmental seal for the internal components.

The ratio of the aperture size to the size of the product is important for achieving optimum performance. The sensitivity of the detector is measured at the geometric center of the aperture, which is the least sensitive point. This is inversely proportional to the size of the aperture, in particular, to the smaller of the two sides.



In all, there are three coils in the system. The transmitter coil generates a field, rather like a radio transmitter. This process, designed to make a metal particle identifiable, is called 'illuminating' the metal particle. The second and third coils are receivers, connected together to detect the presence of an 'illuminated' metal particle. The response is related to the conductive and magnetic properties of the metal.

Control and the Signal Processor

Controls can be mounted on the search head itself, or remotely, depending on the design and the application of your system. Where the controls are mounted does not affect the performance of the system. The signal processor is highly sophisticated. When a typical metal particle is 'illuminated,' the signal value of the receiver coils is one millionth of a volt. First this is amplified by a high-performance RF amplifier, then modulated down to low frequency. This provides amplitude and phase information. Finally, the signals are digitized and digitally processed, to optimize the sensitivity.

Magnetic Field Systems for Foil-Packed Products

These systems operate on a totally different detection principle. They work by incorporating a tunnel or passage which is subjected to a strong magnetic field and as a result, any magnetic material (such as a metal fragment with a ferrous content) is magnetized as it passes through. Incorporated in the tunnel are a series of coils. When the magnetized particle passes under them, a current is generated which is then amplified by the electronics of the detection system and this is used to trigger the detection signal output.

Secondary effects, due to the movement of any conductive material in a magnetic field, will also generate signals for non-magnetic metals. However, these are small compared to the effect generated by materials with a magnetic content. Consequently, only the largest pieces of non-ferrous metals and stainless steel can be detected. In the majority of applications, this technology is only applicable to the detection of ferrous metals.



Guide to Metal Detection

The user interface provides the means of communication with your metal detector system to provide reports for compliance records. Loma's data management system meets the strictest quality control standards set in conjunction with the world's leading retailers.

The User Interface

The user interface provides the means of communication with the system, allowing you to set up and to optimize it to operate with the application, environment and mechanical handling systems. Microprocessors have enabled a wide range of communication links, statistical analysis and system information.

In the case of Loma Systems' metal detectors, network modules (Loma eNet) can be fitted to each of up to 40 metal detectors eventually connecting all to a printer or PC, providing coordinated operational and management information within seconds. The networking of information can also be linked with Loma's PVS, Performance Validation System for metal detectors, which was developed in accordance with the strictest quality controls of the world's leading retailers. The resulting combination of user information incorporates data, not only in regard to the detection of metal, but also on the quality of the metal detectors' performance.

Search Heads: Configuration

Search heads can be used in a variety of configurations. The most common, as shown in *diagram 2*, is mounted on a driven conveyor which has either a fixed or variable speed. When a contaminated product is detected, it is rejected automatically. Metal Detector search heads can also be configured in a slim-line case and mounted on to the conveyor of a checkweigher. This creates a compact, space-saving 'combination' system. Equally, a search head can be configured to operate in a freefall mode, where the product moves down through a gravity-based system, as shown in *diagram 3*.



Loma eNet is a PC-based software package that collects performance data from metal detectors, checkweighers and x-ray inspection systems.

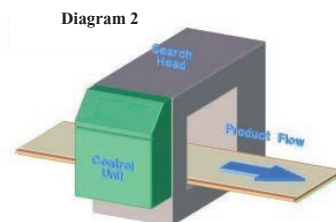
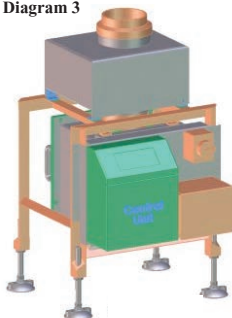


Diagram 2

Diagram 3



Other search head configurations include those used in pipeline systems for pumped products such as meat and gravity-fed, small aperture systems for items such as tablets.

How to Optimize the Performance of Your Metal Detector

Loma Systems: The Voice of Experience

Ever since Loma Systems was founded in 1969, the company has worked very closely with both food manufacturers and retailers around the world. As a result, Loma has an unrivalled level of experience and expertise, in the practice of effective metal detection with food industry production lines. The following guidelines are drawn from Loma's extensive background of 'best practices' and are designed to help you conform to the industry's most rigorous demands for quality control.

What the System Should Include

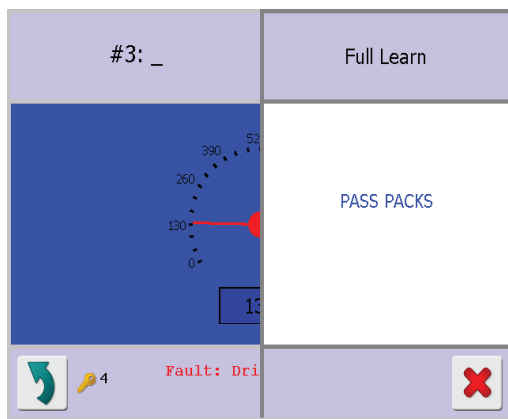
Your metal detection system needs to be positioned in line with the main production flow, after or at the end of the finished packing point. The system will be unaffected even if there is excessive water or steam at that point.



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“We wanted flexible systems that could cope with our constantly changing lines, as we inspect approximately 35 unique fresh and frozen pastry products. Metal detectors that are simple to set-up and can minimize downtime were essential to our decision. After testing, the Loma IQ3 metal detector was the best choice.”

Michael Lerman
Supervisor
Del's Pastry
Ontario, CAN



For optimum sensitivity to your unique application, the metal detector system can be automatically adjusted from the user interface.

Conveyor based metal detectors must include the following for the most efficient performance:

- An efficient automatic rejection system
- A lockable box to receive the rejected product
- A full enclosure between the search head and the rejection bin
- A device to confirm that the contaminated products have been successfully rejected into the bin
- An automatic belt stop failsafe system to activate if there is air pressure failure, a detector fault, failure of the reject system or when the reject product collection bin is full

Pipeline systems must include an audible and visual indication of rejection and freefall systems require the facility to produce a double pack, if an automatic reject system is not possible.

Foil-Packed Products

Ideally, products to be foil-packed should be passed through a conventional metal detector system BEFORE they are packed in the foil. When this is not possible, products packed in aluminium trays or wrapped in aluminium foil must go through a ‘ferrous-in-foil’ detector, such as the Loma IQ3 Ferrous-in-Foil system. Alternatively, consider the additional benefits of using x-ray inspection at this point.

For products wrapped in metallized film, ‘compensated’ conventional detectors or freefall detectors should be used to detect both ferrous and non-ferrous metals.

Sensitivity

For optimum sensitivity, the search head must be of the size appropriate for the specified food product. It is important that the best attainable sensitivities are established and set for each product, relating to product size, type and packaging. This process should only be carried out in consultation with the manufacturer of your metal detector.

If you move your detection systems within your premises, or if you introduce new products, your system must be re-evaluated. Again, this should be done in consultation with its manufacturer.

Many leading retailers will insist that their suppliers of private label goods agree to clarify any changes in metal detection sensitivity settings with them and in writing. If your company is a private label manufacturer, Loma Systems strongly advises you to clarify the preferred policy with each of your retailer customers.

Sensitivity adjustment controls must not be accessible to untrained employees. Access should only be given to nominated, fully-trained staff and for additional security, the controls should be password protected or kept locked.

Obviously, you will want to maximize the sensitivity of your detection system. However, you need to guard against potential instability, where the effects of product and/or environment could cause false rejects.



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Aperture Height	Dry Product		Wet Product	
	Ferrous & Non-Ferrous	Ferrous	Ferrous	Non-Ferrous
Up to 50mm	1.0mm	1.5mm	1.5mm	2.0mm
Up to 125mm	1.5mm	2.0mm	2.0mm	2.5mm
Up to 200mm	2.0mm	2.5mm	2.5mm	3.0mm

Use the above sensitivities as guidelines.

Types of Contaminants

There are three main groups of metallic contaminants:

- Ferrous
- Non-Ferrous
- Stainless Steel detection depends on the magnetic or conductive properties of the contaminant

Ferrous is both magnetic and conductive so it is easily detected. Non-ferrous is non-magnetic but a good or excellent conductor so it is relatively easily detected. Stainless steel is the most difficult contaminant to detect as it is usually non-magnetic and a poor conductor.

Stainless steel comes in various grades, some of which are magnetic and varying to completely non-magnetic. Their conductivity also varies but is generally low. Both of these factors contribute to poor detectability.

Processing plants in the food, packaging and pharmaceutical industries use the two most common grades, 304(L) and 316. The detectability of these grades are further hindered when the product is wet, contains a high salt content, or both, which thus contributes to a high product signal.

As the properties of stainless can be modified by machining (increasing the magnetic effect), specific sensitivity figures are difficult to quote. In general it can be expressed as a ratio to ferrous, at best 1:1.5 rising to 1:2.5.

Further complications are the orientation of contaminants such as screen wires and thin slivers (such as swarf) if the smallest dimension is smaller than the detectable sphere size.

Equipment Testing Procedures

Metal detection testing procedures must be clearly documented and communicated to all relevant staff. Testing should take place at the start of each shift, between each change of product and in any circumstance, at least hourly.

Intervals between tests need to be short enough that if a fault is found, products potentially affected have not left your premises and can be identified, recalled and retested. Once again, if your company is a private label manufacturer, ensure that you agree upon any variation you make to testing procedures, in writing, with your retailer customers.

As mentioned above, to facilitate effective testing, all of Loma's IQ3 metal detectors have an integral PVS (Performance Validation System) feature. This feature automatically prompts the operator to carry out the required test at a pre-set interval.

Conducting Test Routines

When you test conventional metal detection systems, you need to use both ferrous and non-ferrous test packs. These should be made up from packs that are proven to be free from metal and are clearly marked and labelled so they cannot be packed inadvertently for dispatch. You need to make fresh test packs at a frequency that reflects the nature, durability and shelflife of the product concerned. If you use 'stale' test packs, they will not reflect the same properties as the products which the metal detector is inspecting.



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In the case of Loma Systems metal detectors, your system comes with a ready supply of plastic 'wands' which contain pieces of various metals in the specified test sizes. These are convenient and easy to place into your test packs and also make the testing process even more efficient. When you are testing finished packed products on a conveyor system, place the test piece of metal, where possible, at the extreme end of the pack. If this is impractical, for example, if you are testing individual small packs or sandwich wedges, place the test piece of metal in the center of the product.



Next, pass both ferrous and non-ferrous test packs individually through the search head two times. First, with the metal test piece at the leading edge of the pack and then with the test piece at the trailing edge of the pack. In each case, you must observe that the test piece successfully enters the reject bin.

In the case of unwrapped products, make every effort to fit metal detection equipment on your production line AFTER products are wrapped. Where this is not possible and you are manufacturing private label goods, it is advisable to agree to the testing routine, in writing, with the retailer concerned.

With freefall systems, place ferrous and non-ferrous test pieces independently in the product flow and observe appropriate rejection. This principle applies similarly to pipeline systems. However, where that is not practical within a pipeline system, insert the test piece between the pipe and the search head and then observe for the appropriate rejection. Should any part of your test fail, isolate all products produced since the last satisfactory test and re-screen them, using another detector functioning to the same standard as the original system performing the test.

Dealing with Rejected Products

Needless to say, no rejected product must ever be returned to the production line. However, this does not include products rejected during normal test procedures. If these products are in a sound condition, you should replace them in the product flow for them to be re-detected.

Rejected packs must be investigated by a suitable, trained person, within one hour of rejection. Frozen products must still be frozen, or refrozen. The investigation should be carried out using the metal detector system which initially rejected the products, but not while it is being used in actual production. If you cannot stop the production line, use an off-line detector with at least the same, if not higher sensitivity.

Pass the rejected products through the detector positioned in the same way as they were when they originally went through the search head. Then pass the same products through the search head twice more, each time positioned in different ways. If at any stage the products are rejected again, it is essential to find the contaminant and identify it. Then, take any necessary action to ensure similar contamination does not recur. Having more than one metal-contaminated product rejected on a single production line within a shift, is a matter of great concern. Every effort must be made to ensure the identification and elimination of the cause. If you are manufacturing private label goods, you should inform your retailer customers, in writing, about the incident.

Maintaining Your Metal Detection Equipment

As with any piece of vital precision machinery, high performance can only be assured if your metal detector is regularly and properly maintained. So, it is worth instigating a planned program of preventative maintenance for your systems to take place at regular intervals, in accordance with the manufacturer's recommendations.

Maintenance should be carried out by the original manufacturer. It can also be done by your own engineers, provided that they have been trained by the original manufacturer. After any repairs, maintenance or adjustments, you need to ensure that a full metal detector test is performed before you use the system again.

Training Your Staff

For maximum efficiency and safety, all relevant staff should be properly trained in the principles and use of metal detection equipment and the use of testing routines.



Guide to Metal Detection

Documents and Record Keeping

It's important that you keep all relevant documentation and records covering a number of areas. These areas include:

- Commissioning and sensitivity tests and records for new equipment, and also those following the movement or relocation of equipment
- Results of routine tests showing time, result, sensitivity, product and any action taken
- Number of rejected packs each shift
- Number and details of detected contaminants
- Action taken to trace source of contaminants
- Planned preventative maintenance program and service work
- Personnel training

Preventing Metal Contamination by Maintenance and Cleaning Work

All your organization's maintenance and cleaning staff should receive appropriate training on how important it is to prevent metal contamination. The maintenance of your factory equipment should be planned, so that wear and tear can be remedied before defects occur. Try to ensure that any maintenance work or installation of new plant equipment is done outside of production hours. If that is not possible, then the area must be properly screened from adjacent raw material production or packing areas.

Repairs on production lines should be carried out by staff using an enclosed box for their tools. It is helpful if they use a small vacuum brush and magnet for cleaning afterward, where this is appropriate.

Under no circumstances must welding, riveting, drilling or soldering be done on a system being used for production, or on any system immediately adjacent to it.

Slicing or mincer blades, woven wire conveyors and sieves must be inspected every day for any signs of damage. This inspection needs to be clearly documented.

Maintenance and cleaning staff who dismantle equipment should carry a suitable, clearly marked container for the safe storage of nuts, bolts, washers, etc.

Staff must avoid using tape or wire to make temporary repairs to equipment. Missing or loose screws and damaged fittings need to be replaced or repaired promptly and permanently and swarf, wire debris and any other potential contaminant disposed of safely and quickly. All welding should be continuous and smooth.

It is important that all equipment repaired in workshops or in the factory is cleaned down and vacuumed (not blown with compressed air), before being returned to the production area. Workshop floors need to be swept and vacuumed at least once daily. Where workshops are within your factory building, a suitable trap should be fitted to the workshop exit, accompanied by a notice informing personnel to scrape their footwear before leaving.

Once repairs, maintenance activities and installations are complete, a member of the Quality Control team should inspect the plant and the surrounding areas BEFORE production starts again.

Loma Systems: Quality Inspection Respected Across the World

Helping You Achieve 100% Metal Detection

Whatever your product or process, there is a Loma IQ3 metal detector to suit your requirements. Whether your products are wrapped or unwrapped, on a conveyor or in a pipeline, the Loma IQ3 will detect any metal contaminated product and remove it. If, on the other hand, your products are wrapped in foil, the Loma IQ3 Ferrous-in-Foil metal detector system will detect and reject any ferrous particle contaminated product and reject it with the same exacting precision.



Guide to Metal Detection

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An Automatic Choice for Checkweighing

The Loma range of checkweighers will accurately weigh products from only a few grams up to 45kg. Running at speeds of up to 450ppm, with accuracy from just +/-0.2g, the performance is outstanding.

A Perfect Combination

The Combination system brings Loma's market leading metal detection and checkweighing technologies together in a single, compact, space-saving unit.

Excellence with X-ray

To fully inspect products for metallic and non-metallic contaminants at high line rates, Loma's X4 range of x-ray inspection equipment uses advanced image processing technology. Proprietary image processing and 3D modeling software automatically optimizes sensitivity for each individual product simplifying product set-up and minimizing changeover times. Models for package, bulk and pipeline applications ensure optimum designs to suit your process.

A Complete Solution for Quality Inspection

To give you even greater control over production, Loma eNet, Loma's data management software, collects key production line data from Loma metal detectors and checkweighers. Loma eNet then presents this information in an easy-to-view format on a central PC.

A Dedicated Service Team Working for You

Maximize the return on your metal detection, checkweighing or x-ray inspection system investment through one of our service programs. Our certified field technicians help you maintain system accuracy and functionality for complete peace of mind. We understand nothing is more important than keeping your inspection systems running at all times.

About Loma Systems

Loma Systems is the world's leading engineering and manufacturing company specializing in metal detection, checkweighing and x-ray inspection systems. Our products are uniquely engineered for consistent quality with a low cost of ownership. We have successfully partnered with the world's largest food and packaging companies, located in over 100 countries, to comply with product safety standards and retailer codes of conduct.

Loma has over 120,000 metal detection systems installed worldwide and the IQ3 technology is the premier inspection system on the market today.

For More Information

To learn more about the IQ3 technology featured in this guide, please visit: www.loma.com

