# The returns on preventing metal contamination

***by Neil Giles, Mettler-Toledo Safeline Ltd, Montford Street, Salford, M50 2XD, UK.***

Metal detection is a proven and reliable technology for product inspection in the food industry. But are manufacturers getting the best from their systems?

Experience shows that, rather than simply purchasing and installing a metal detector, developing a complete metal detection programme delivers valuable benefits far beyond the mere removal of metal contamination. Such schemes will maximise product safety, ensure the protection of manufacturers' brands, provide an optimum return on investment and ultimately, increase profitability for the business.

The main purpose of a metal detector is, of course, to prevent metal contamination reaching consumers in a food product.

In addition, it can protect valuable equipment down the line from excess wear and damage.

Contamination can originate from a number of sources, including contaminated raw ingredients, poor working practices during equipment installation and daily operations, or a lack of preventative maintenance procedures. All potential sources should be identified and incorporated into the metal detection programme. It is often useful to check the records of past contamination incidents, where the nature and possible source may have been identified. Maintenance records may also identify potential sources.

Inspecting raw materials when they arrive at the manufacturing facility offers the benefit of detection and removal of large contaminants before they are potentially broken into smaller pieces that are not only much more difficult to find later in the production process but in the process of being broken up may damage vital equipment resulting in further contamination.

Food manufacturers can and should, where possible, ensure that suppliers take full responsibility for the quality of their products by adhering to strict guidelines which may include the operation of an effective metal detection programme similar to their own.

The production process itself is another major source of potential metal contamination. Planned and preventative maintenance is essential to the effective operation of any metal detection programme and can help to halt any contamination caused by malfunctioning equipment including broken or loose blades, swarf, sieve wire etc. Good engineering and manufacturing practice will ensure that defective equipment is repaired under controlled conditions so that potential problem areas are identified promptly.

Retaining records of defective equipment and procedures carried out to correct non-conformance are crucial when reviewing the effectiveness of the planned maintenance programme and incident resolution.

## Perfect positioning

The optimum positioning of a metal detection system is important because this can have an impact on inspection efficiency as well as delivering possible cost savings. HACCP (Hazard Analysis and Critical Control Points) techniques identify potential sources and types of contamination and pinpoint the necessary inspection points (Critical Control Points, or CCPs) in the production process.


Appropriate equipment should be located where it can identify and remove the contamination as early as possible. Where feasible, the metal detectors should be integrated into the normal production flow to avoid possible confusion about which goods have been inspected. The factory environment plays a key role during the siting process and must be assessed because it could have an adverse effect on operational performance – an element discussed at greater length later in this article.

As a minimum, the end of every production line should be viewed as a CCP for metal contamination. If products cannot be inspected immediately after packing, systems should be installed as close to that point as possible: immediately before packing. In situations where it is impractical to carry out finished pack metal detection, such as canned foods, alternative control systems must be agreed with customers prior to installation.

In this instance, the solution may include the installation of pipeline metal detectors in the process line just before the can filling takes place.

***Table 1. Typical sensitivity standards demanded by major retailers.***

| Aperture height | Dry products* | | | Wet product and metallised film packed products* | | |
|---|---|---|---|---|---|---|
| | Ferrous | Non-ferrous | 316 stainless steel | Ferrous | Non-ferrous | 316 stainless steel |
| Up to 50mm | 0.8 | 1.0 | 1.2 | 1.5 | 2.0 | 2.5 |
| Up to 125mm | 1.0 | 1.2 | 1.5 | 2.0 | 2.5 | 3.5 |
| Up to 200mm | 1.2 | 1.2 | 2.0 | 2.5 | 3.0 | 4.0 |

*all figures are stated in mm and are intended for guidance only

## Reliability and sensitivity

Attainable equipment sensitivity is dependent upon many variables including product size, type and packaging material used, and should be determined following consultation with metal detector suppliers.

For optimum consumer protection, systems should be set for the maximum sensitivity performance that is available, while remaining stable and reliable.

Food retailers' requirements have progressed beyond the basic demand that metal detection systems be installed. They are now more frequently establishing strict guidelines regarding operational sensitivity, and manufacturers should consider these as the minimum acceptable standards. If more stringent standards can be applied practically, processors will be able to offer a safer and higher standard of product to customers and consumers.

*Continued on page 7*

*Continued from page 5*

Equipment manufacturers are ideally positioned to help manufacturers establish sensitivity standards – expressed as minimum detectable ball sizes. These can be established when specifying the equipment ensuring that in-process stability is maintained in order to avoid instances of false rejection.

Performance can be confirmed during commissioning trials.

Maximum operating sensitivity performance will be balanced with the practicalities of implementation and enforcement. Table 1 shows typical sensitivity standards demanded by major retailers.

## The ideal installation

When installing and commissioning equipment, a number of points should be considered that may affect the long term performance of inspection equipment.

These include ensuring a 'metal free zone' is present around the detector, keeping its location free from excessive vibration or mechanical shock and, where possible, avoiding locations in proximity to sources of electromagnetic interference such as radio transmitters and other electronic equipment.

Following this guidance will provide the manufacturer with the optimum environment for successful contaminant inspection.

As part of the installation process, leading metal detector suppliers will provide an experienced engineer to ensure that any local relevant legislation is met, performance is optimised, operator training has been completed and the detector qualification process has been carried out correctly.

Once correctly installed, metal detectors should be audited and tested regularly, as defective equipment may allow contaminants to continue through the production process unidentified. As part of the preventative maintenance process, manufacturers can call on the experience of engineers and technicians who can quickly and easily identify potential equipment and/or programme problems before they become an issue.

## Performance validation

After inspection equipment is installed and fully operational, regular validation of the whole system is still required.

This will ensure compliance with product standards and the overall metal detection policy, and will also demonstrate due diligence.

Validation tests are used to ensure that there has been no significant change in the detector sensitivity or settings since the previous validation test.


Best practice is to test equipment using three contaminant types – ferrous, non-ferrous and stainless steel – assuming these metals are all potential sources of contamination.

If these tests are not practical, a compromise would be to focus testing for stainless steel on wet/conductive products and, in dry applications, for ferrous metals (and non-ferrous metals at higher frequencies). This regime, carried out using test samples from metal detector suppliers, will still highlight any changes in sensitivity performance which can have an adverse effect on detection capability.

When conducting performance tests, samples should be positioned where they are least likely to be detected, offering the greatest challenge for the detection system. The importance of the correct positioning of the test piece should not be underestimated. Incorrect positioning may significantly impact the performance of the detector and reject device.

It is considered good practice to carry out testing at the beginning and end of each daily production shift. Validation tests should also be carried out following batch changes, machine setting adjustments and especially after periods of downtime.

Such tests are essential in proving due diligence – a key requirement of all manufacturers to satisfy major retailer demands. In addition to ensuring that the metal detector is performing to the required sensitivity standard, it is important to test that the reject device is functioning correctly.

Documentation of validation test results will demonstrate that all requirements of the validation procedure were met. If any validation or part of validation test fails, production should not restart until the cause has been investigated and rectified. This not only guarantees equipment performance, but ensures the safety of products and the protection of the manufacturer's reputation.

## To suspect and reject

If goods are rejected by the metal detection system during routine operations, they should be considered as contaminated until proven otherwise.

Evaluation of the suspect product should take place as soon as possible. The contamination may be an isolated incident, but if it is the early indicator of failing machinery, the sooner it is identified, the better.

Regardless of the cause of contamination, no product manufactured on the line since the last successful test should leave the site until investigations are complete.

To confirm contamination, the rejected product should be passed through the metal detector again, in multiple orientations. If, upon these further tests, no contamination is found, the suspect product can be considered acceptable. Should there be another rejection by the inspection system, manufacturers are advised to remove packaging materials and re-test the product itself.

If the product is once again rejected and the metal contamination cannot be located visually, the product should be divided into smaller pieces and re-tested until the metal is found. This will allow the production team to identify any sources of contamination that may need attention.

It is vital that manufacturers have a clearly defined process for dealing with contaminated product, from the point of identification through to root cause investigation and final resolution. The results of this process, including details of the contamination, its source and actions taken, should be fully documented for future reference, ongoing analysis and regulatory compliance.

| Generic carrier type | Typical applications |
|---|---|
| Test card | Conveyor lines with discrete packed products |
| Test stick | Conveyor lines with bulk product |
| Test tablet | Pharmaceutical and nutraceutical applications |
| Test ball/bung | Gravity feed inspection of powders and granules and inspection of liquids, pastes and slurries where test sample retrieval is possible |
| Test rod/wand | Gravity feed inspection of powders and granules and inspection of liquid, pastes and slurries where test sample retrieval is not practical |

## Analysis and improvement

The effectiveness of the inspection programme can only be evaluated with efficient collection of data and trend analysis. Using this information over a period of time will assess the value of the metal detector and be the first step in quantifying any savings or increased profit that has been generated.

In order to evaluate system effectiveness, it is important to investigate all instances of contamination, rejected products and customer feedback. The number of rejects and complaints should be monitored over time to make sure improvements are being made and any underlying common causes are identified and eliminated.

## Summary

In a modern highly accountable business environment, food manufacturers need to optimise both the performance and value of their metal detectors. They can no longer be viewed simply as a means to remove metallic contamination: their role is far more important.

A comprehensive and effective metal detection programme will maximise safety, meet retailer standards, ensure regulatory compliance, protect equipment and protect the brands of both food producers and their customers.

The ultimate imperative is that it protects consumers and justifies the trust they place in food providers to offer them safe products.

The final outcome of effective metal detection programmes is that the trusted producer will retain customers' and consumers' loyalty and grow its sales and profits. n

FaxNOW +44 161 848 8595
✉ safeline.info@mt.com