# Metal detectors: Ten tips for achieving reliable long-term performance

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**Electronic metal detectors for dry bulk solids applications are highly sensitive radio-frequency instruments that need regular TLC. Here are 10 practical tips for keeping your metal detector on top of its game for the long term — reliably rejecting contaminated material while letting good product keep on flowing.**

Metal fines and larger debris (*tramp metal*) can get into dry bulk solid products, including foods, pharmaceuticals, chemicals, and others, from several sources. While careful equipment design and operation can prevent many sources of metal contamination, it's impossible to entirely eliminate metal from contaminated ingredients and imperfect processes. That's why metal detectors for locating and rejecting products contaminated with metal are a critical element of many processing lines and especially in FDA-recommended Hazard Analysis and Critical Control Point (HACCP) programs.[1]

No matter how much research you put into selecting a metal detector for your processing line and how carefully you install the detector, over time things can go wrong with this highly sensitive electronic device. A metal detector with problems can not only cause your manufacturing process to fail customer audits, but result in lost customers, quarantined product lots that must be rescreened for contaminants, and excessive amounts of scrapped or reworked product. A poorly functioning metal detector can also lead to problems that result in unfavorable press about your product brands or even lawsuits against your company.

The best way to avoid these negative outcomes is to follow some practical, common-sense advice for keeping your metal detector performing at peak levels. Let's start with examining how the metal detector works.

## Metal detector basics

An electronic metal detector is installed in a processing line so that the product stream (or packaged product) flows through an aperture inside the detector's housing. As the product flows through the aperture, the detector electronically senses the presence of metal contamination and sends a signal to a mechanical reject device to remove the contaminated product from the line.

A typical metal detector includes three basic electronic elements: a radio-frequency (RF) transmitter and receiver, a set of transmit-receive coils leading from the transmitter and receiver, and a microprocessor detection-and-control system. In operation, a transmit coil located in the detector's aperture sends an oscillating electromagnetic field signal from the RF transmitter-receiver to two receive coils on either side of the aperture, creating an electromagnetic balance between the coils. This balance is continuously processed by the detector's microprocessor detection-and-control system. When a metal particle passes through the field, it absorbs a small part of the field's energy and disrupts the balance between the coils. When the receive coils detect a change in this balance, the microprocessor system sends a signal to the reject device, which removes the suspect product from the processing line.

Properly installing, operating, and maintaining your metal detector as outlined in the following ten tips can help you ensure that the detector reliably rejects contaminated material for many years to come.

## 1 Remove as much vibration from the metal detector as possible.

Even the smallest movement of the metal detector's transmit-receive coils in relation to the housing can reduce the detector's sensitivity. For this reason, you need to mount the detector in a way that minimizes vibration. Make sure that the mounting isn't attached to process equipment that's likely to create vibration, such as mixers, feeders, and baggers. To prevent high false-reject rates and reduced detection sensitivity that can be caused by vibration, your metal detector should be equipped with a feature that allows it to recognize vibration signals and cancel them out. If your detector has this feature, make sure that it's enabled.

## 2 Make sure that the metal detector isn't receiving "noisy" power.

Because the metal detector is designed to reject product when it detects small signal changes, noise spikes or ripples in the power lines leading to the detector can fool the unit into thinking metal is present and cause false rejects. For this reason, make sure that you use a dedicated power circuit for the detector. It's not the easiest or least expensive power setup, but it will help the detector provide the best possible performance in your processing line.

## 3 Prevent any variable-frequency drives in your processing line from "talking" to the metal detector.

Variable-frequency AC drives are great for controlling the speed of processing equipment, but they can emit a lot of electromagnetic noise. This noise can interfere with your metal detector's electronics and cause false rejects. To debug this problem, turn off each processing machine near your metal detector, then turn each back on one at a time and monitor how its operation affects the detector. If any processing machine disturbs the detector's operation, call the machine's supplier and follow the supplier's recommendations for using an external noise suppressor on the machine. Such a device typically removes the electromagnetic noise affecting your detector.

## 4 Match the metal detector control settings to your product.

Once the metal detector is installed, you need to set up the detector's sensitivity for each product the detector will handle so it can ignore any product characteristics that interfere with metal detection. For instance, a salty or moist product is somewhat conductive, and to avoid false rejects the detector must ignore these characteristics during handling. You can quickly program the metal detector for each product with a few simple button pushes on the detector's control panel, or, if the detector is linked to a PLC or other control system, by programming the control system. Once the detector has been programmed, each time you change products you can quickly select the current product's correct control setting from the detector's memory. For handy operator reference, you can also create and laminate a brief set of control setting instructions and keep them next to the metal detector.

## 5 Regularly test the reject device.

In most cases, the reject device is set up to "fire," or go off, at a fixed distance from — or a fixed time after the suspect product passes — the metal detector. The device is also typically set up to fire for a certain duration. Thus, if the reject device is moved or the processing line speed is changed (and not sensed by a speed sensor linked to the metal detector), the device may not correctly reject the contaminated product. To check that your reject device is working correctly, you can periodically run this simple test, which takes only a few seconds: Pass a metal test piece through the processing line and monitor when and how the reject device removes it. If the device misfires, all you typically need to do is change the detector's control settings.

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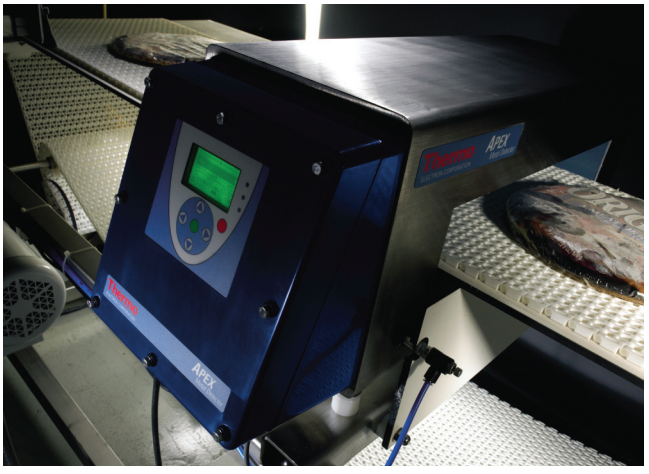
## 6 Regularly test the metal detector for the worst-case detection scenario.

The least-sensitive spot in the metal detector's aperture is at its center, where the metal is inside the product stream




***When properly maintained and calibrated, an electronic metal detector, such as this one operating in a food plant, can reliably reject contaminated product for many years.***

or package and at the farthest possible point from the transmit-receive coils. However, the standard method for testing (or *auditing*) whether the metal detector is sensing metal contaminants is to place a metal test card on top of the product steam or package, where it's quite close to the coils. Clearly, this isn't a good way to measure the detector's ability to sense metal at the aperture's center — the worst-case scenario. To test the detector for the worst case, you'll need to develop a method that tests the point in your product stream or package that's farthest from the aperture's center. For a packaged product, for instance, this may involve embedding a metal piece in the center of one filled package, and then keeping that package near the detector so it can be regularly and quickly run through the detector to test its worst-case detection sensitivity.

## 7 Make sure that your product conveying system isn't contaminated with metal.

Metal can get into anything in a processing plant, including the conveying system carrying product past your metal detector. One common contamination source is a conveyor belt. You can typically tell if the belt has been contaminated by checking the detector's control panel display for a peak in the signal at regular intervals. If you see such a peak, clean or replace the belt. It's also good practice to change the belt during your processing line's regularly scheduled preventive maintenance downtime. Regularly monitoring your process equipment for contamination is important for another reason, as well: If the equipment is contaminated, an operator may deal with it simply by changing the detector's control settings to desensitize the detector to the contamination, leaving you unaware that the settings have been changed.

## 8 Keep water from leaking into the metal detector.

A metal detector can typically take regular, thorough washdowns and keep running for years. Yet the detector's seals can eventually wear out, creating water leaks. You can prevent leaks by making certain that the control panel is tightly connected to the detector and all incoming and outgoing electrical cables are properly sealed. Also periodically inspect the aperture to make sure its protective coil liner isn't damaged. If water has leaked into the detector, the damage can often be repaired, but this typically involves shipping the detector back to the factory.

## 9 Have a trained technician test the metal detector's electromagnetic balance.

The metal detector's electromagnetic balance is set at the factory before it's shipped to you, and the detector typically has a self-correcting electronic circuit that keeps it in balance. Occasional false rejects can be a signal that your detector is out of balance. Potential sources of this problem are thermal cycling — that is, extreme temperature changes in the plant environment — and mechanical shocks, such as from dropping the detector during transport. If your metal detector is falsely rejecting good product, check the balance indicator on the detector's display panel. If it shows that the detector is out of balance, call a trained metal detector technician to rebalance the unit. This technician can be from the metal detector supplier or a certified independent service person. To prevent balance problems, provide regular preventive maintenance, including keeping the detector isolated from vibration and preventing water leaks into the detector (as discussed in Tip 8). Such maintenance is a lot cheaper than having to recall contaminated product after it's been shipped to your customer.

## 10 Call in the experts for regular preventive maintenance and calibration.

The technical skills required for maintaining and calibrating your metal detector may go beyond your maintenance staff's capabilities. That's not uncommon, and it's why all metal detector suppliers offer the services of trained technicians for checking, calibrating, cleaning, and certifying your detector. Many times, these services are just what you need to keep a manufacturing-process auditor happy too.

**PBE**

### Reference


1. For more information on Hazard Analysis and Critical Control Point (HACCP) programs, contact the FDA Center for Food Safety and Applied Nutrition, 5100 Paint Branch Parkway, College Park, MD 20740-3835; 888-723-3366 (www.cfsan.fda.gov).


### For further reading

Find more information on metal detection equipment in articles listed under "Metal detection/separation" in *Powder and Bulk Engineering*'s comprehensive article index at www.powderbulk.com and in the December 2007 issue.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