



WESTERN PROTECH

Training, Certification and Repair for your Metal Detection Systems

Western Protech • P.O. Box 1018
Coarsegold, CA 93614
Telephone: (559) 641-7760
Fax: (559) 641-7660
service@westernprotech.com

METAL DETECTOR

TROUBLESHOOTING GUIDE

There are many things that can interfere with the proper operation of a metal detector. Easily 80% of "metal detector" problems are found to be caused by outside influences rather than the metal detector itself. Metal detector troubleshooting can be a frustrating experience, if you don't check the following, most common causes of poor metal detector performance.

1. SYSTEMATICALLY NARROW YOUR SEARCH

While finding the exact source of the problem may take some time, it is relatively easy to narrow the search. If a metal detector starts to false reject, remove any product from the system and turn off the conveyor. If the detector continues to reject then the problem must be electrical interference or a problem with the metal detector itself. If the detector stops rejecting it is normally safe to assume that the detector itself is ok. Now start the conveyor and see if the detector begins to false reject. If it does then the problem is in the conveyor, possibly metal embedded in the belt or some type of ground loop problem. If all is still fine then begin to run product through the system. If the detector rejects on each product or on occasional product then the detector is not set up right for that product and adjustments must be made.

2. CHANGING OR INCONSISTENT PRODUCT

If a metal detector is set up to run frozen product and occasionally a semi-thawed product comes through the detector it will cause a false reject. This is because the detector is set to recognize the signal from the frozen product as a normal signal and since the signal from the semi-thawed product is different, the metal detector assumes that the signal is different because there is metal in the product. This is true if any of the product characteristics change suddenly.

3. TWISTING OF THE METAL DETECTOR HEAD

It is very important for metal detectors to be mounted on a flat surface. An incline, decline, or vertical mount is not the important consideration as long as the surface is flat. An uneven surface will cause the metal detector body to twist or strain when the mounting bolts are tightened. This causes the metal detector to be unstable and can cause false rejects. Also, if the metal detector is mounted to a conveyor or support stand it is important for the feet of the conveyor to be firmly on the floor, if the conveyor or stand rocks it will create the same effect.

4. EXCESSIVE VIBRATION

Most metal detectors can handle quite a bit of vibration without a loss of sensitivity. Severe vibration, especially sudden jarring bumps or high frequency vibration can cause false rejects. This problem will be amplified if the metal detector is running in the wet or conductive mode.

5. POWER LINE INTERFERENCE

Today's metal detectors are sophisticated electronic devices. They require a power source that is free from power line "noise". The noise, or voltage spike, can be caused by a variety of other equipment running on the same power source as the metal detector. The most common sources of these spikes are motors, heaters, sealers, or any other high current load. Metal detectors have some noise suppression circuitry built into them but if the spike is large enough it will cause the metal detector to false reject.

6. RADIATED SIGNAL INTERFERENCE

Because the metal detector is made of a transmitting and receiving antenna, it is susceptible to other signals that might be present in the area. False rejects can be caused by such things as V.F.D.'s (see handout) microwave type sealers or heaters, walkie-talkie type radios, or even faulty spark plug wires on a nearby forklift. Any machinery that can cause a burst of energy is a possible source of interference. The best method to minimize the interference is to place a shield around the possible source and electrically ground the shield.

7. GROUND LOOP INTERFERENCE

Many false rejects of a metal detector seem to have no obvious cause and can be very difficult to locate. One of the most common causes is a ground loop. When two pieces of metal make intermittent contact in the area of the metal detector it can cause a false reject. Because the metal detector is basically a transmitter and receiver, there is a very weak electrical field generated around the inspection head. The field will conduct itself through whatever is in its range, whether through the air, or through any metal in the area. As long as the field remains stable all is fine. If there is metal in the field that is making intermittent contact with another piece of metal, the shape of the field changes suddenly and the metal detector will give a false indication. Possible sources of ground loops are loose nuts or bolts, poorly designed reject devices, degenerating bearings in an idler or drive pulley, or even another piece of machinery bumping up against the metal detector system.

8. IMPROPER PROGRAMMING/SETUP

No metal detector can function properly if programmed incorrectly or if setup wrong. Correct programming or setup is essential.

FOR SERVICE CALL Western Protech (559) 641-7760



WESTERN PROTECH

Training, Certification and Repair for your Metal Detection Systems

Western Protech • P.O. Box 1018
Coarsegold, CA 93614
Telephone: (559) 641-7760
Fax: (559) 641-7660
service@westernprotech.com

SOURCES OF INTERFERENCE

TRANSMISSION TYPES:

LINE TRANSMISSION:

Today's metal detectors are sophisticated electronic devices. They require a power source that is free from power line "noise". The noise, or voltage spike, can be caused by a variety of other equipment running on the same power source as the metal detector. The most common sources of these spikes are motors, heaters, sealers, or any other high current load. Metal detectors have some noise suppression circuitry built into them but if the spike is large enough it will cause the metal detector to false reject.

RADIATED SIGNAL INTERFERENCE:

Since metal detectors are radio frequency sensing devices, it stands to reason that broadcast interference carried through the air, will be received by the sensing antenna. The detector has tuned circuits attached to the receiver that allow it to ignore signals that are outside of its operating frequency. However, some sources of broadcast EMI will have broadband (wide spectrum) characteristics and if significant energy lies at the same frequency as the detector's transmitter, then the interference will be passed through the system, usually resulting in unexplained or 'false' rejects. This type of interference is very difficult to overcome and still allow product to pass through the aperture.

SOURCES:

Typical sources of broadcast interference are:

- . Two-way radios- High frequency- Not usually a concern unless closer than 2 meters.
- . Cell phones- Are very high frequency, and not a concern.
- . Radio/TV broadcast- Constant and controlled frequency, not a concern.
- . Switched motor controls (VFD, and Servo) - **Serious problem due to wide spectrum noise source.**

VARIABLE FREQUENCY DRIVES (VFD):

Variable frequency drives (a.k.a.: VSD, ASD) are a major source of EMI in industrial environments due to a general lack of regulation and the failure of field installers to follow recommended wiring and filtering methods outlined by the drive manufacturers. Naturally the drive manufacturers are not eager to stress the potential problems associated with their products.

Modern drives using IGBT switches for motor frequency control are very efficient due to their high switching speed. This has brought down the size and cost of drives and in turn, increased their usage. Unfortunately the high speed switching also results in much higher EMI and RFI is being generated by the sharper slopes of the drive square wave edges. The result is a wide spectrum of noise injected into the drive output cables, and (worse still) back into the plant power buss. These cables then act as broadcast antenna.

All drive manufacturers detail recommended installation procedures that are required in order to prevent excessive noise on both sides of the drive. These can sometimes be very elaborate and are usually ignored by the field installers. As the number of VFD controllers multiply in a plant, the chances of interference with other equipment also multiplies, and if the power buss is affected, the problem can show up in unexpected locations throughout the plant.

The problem of VFD radiation is very well documented by the drive manufacturers, and their publications should be referred to for more information.

FOR SERVICE CALL Western Protech (559) 641-7760



WESTERN PROTECH

Training, Certification and Repair for your Metal Detection Systems

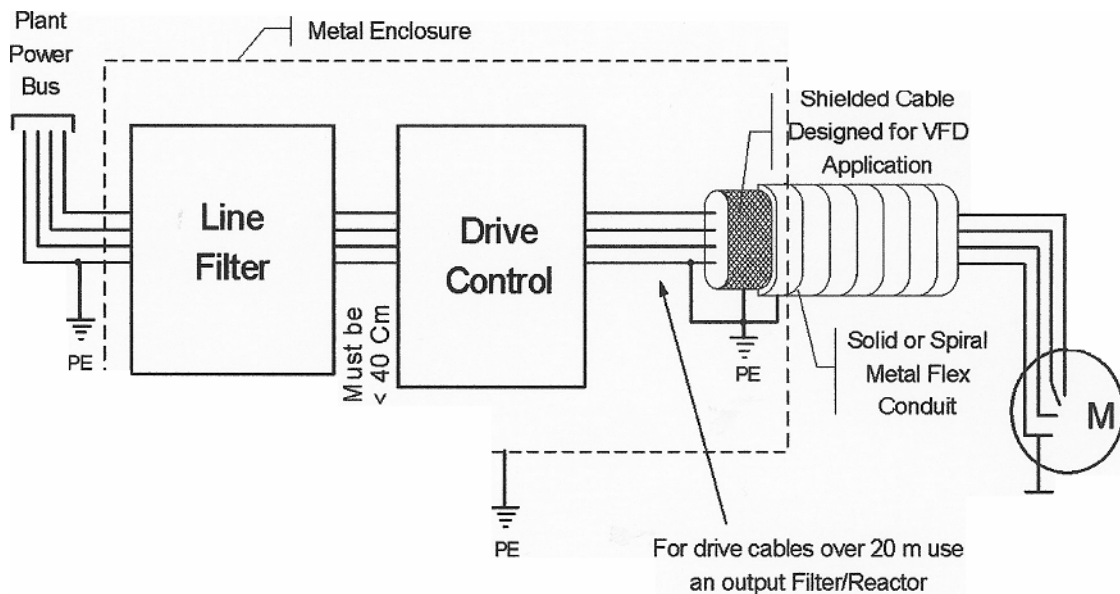
Western Protech • P.O. Box 1018
Coarsegold, CA 93614
Telephone: (559) 641-7760
Fax: (559) 641-7660
service@westernprotech.com

THESE INCLUDE:

- . Allen Bradley (Rockwell Automation): Visit their web site at www.ab.com/drives and select published technical papers. The best and most comprehensive article on drive EMI is "EMI Emissions of Modern PWM AC Drives" by Skibinski, Kerkman, and Schlegel an IEEE paper from 1999.
- . MTE Corporation: Visit their web site at www.mtecorp.com and select technical papers. Suggested Wiring for VFD Systems to Reduce EMI/RFI:

The following must be done to reasonably assure that VFD systems will not broadcast enough interference to cause problems with metal detectors:

- . Install an appropriate line filter to prevent noise injection back into the supply buss.
- . Install VFD and filter in a grounded metal enclosure.
- . Use shielded VFD purpose cable from controller to motor and ground the shield.
- . Install motor (output) cables in metal (grounded) conduit.
- . If motor cable exceeds 20M then an output filter/reactor must be used.



WHAT CAN BE DONE AT THE METAL DETECTOR?

Because the frequency of the RFI generated by a VFD covers the detector's operating frequency, once VFD noise is present in the air, it is almost impossible to cure by changing the detector configuration or its installation.

IT WILL HELP TO:

- . Install aperture extension flanges. Use 'Slow' filter setting
- . Increase detector operating frequency above the worst of the VFD noise band if other operational limitations allow this.
- . Position the detector to be at right angles to the noise source, if practical.

In conclusion, the most likely source of detector interference is switched motor speed controls (VFD, and servo). This interference travels through the air into the detector aperture, not through its power cables.

The best cure for the problem is to install drive controls according to the manufacturer's instructions to reduce EMI/RFI" especially line filtering and output cable shielding.

Some precautions can be taken with the detector but the application and product type can limit what can be done.

FOR SERVICE CALL **Western Protech** (559) 641-7760