Physical Foreign Material Control

Learning Objectives

- Identify sources of physical foreign material
- Categorize physical foreign materials as food safety hazards or quality issues
- Visually inspect shipping/receiving vehicles to evaluate ingredients and raw materials for evidence of contamination
- Follow a statistical sampling plan for ingredients and raw materials to monitor for physical foreign materials
- Inventory all essential glass, brittle plastics, and ceramics (GBPC) at the facility and eliminate all non-essential GBPC
- Protect and inspect any essential GBPC at the facility
- Follow procedures for cleaning up GBPC breakage
- Identify and monitor metal-to-metal wear points in equipment design where product contamination is possible or likely
- Use a control program to eliminate wood in the food plant and control and manage essential wood materials
- Manage appropriate control devices to monitor and control potential sources of physical foreign material
- Explain how employees can monitor for potential physical foreign materials

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What is Physical Foreign Material?

Food safety laws are based on the principle that the food supply must be pure, or free of any foreign material. The Food Safety Modernization Act (FSMA), the Food, Drug and Cosmetic Act (FD&C Act), and most state and local food safety laws place the responsibility for producing a pure food on the manufacturer, requiring that a food must not be adulterated. In fact, the FD&C Act makes it a crime to produce and introduce an adulterated food into the marketplace.

A food is considered adulterated if it contains anything that is not declared on the label or if it has been subjected to unsanitary conditions at any time during preparation, packaging, or storage. Actual adulteration or contamination does not have to be found in the food product to be considered a violation of this section.

It is important to understand the difference between adulteration and contamination. Adulterated food products are made when extraneous, improper, or inferior ingredients are added. It does not necessarily have to be something that will cause harm to the end user or consumer. Contaminated food products are those that contain an adulterant that would cause harm or death to the end user or consumer.

Common examples of physical foreign material include, but are not limited to: wood, glass, metal, plastic, rubber, bone, rock, hair, jewelry, false fingernails or eyelashes, etc. Some physical foreign materials are categorized as food safety hazards and others as quality or consumer complaint issues. Whether the physical foreign material is classified as a food safety or quality defect, all manufacturers should take measures to prevent inclusion in the product.

> An exposed glass light bulb in the operation area broke and glass particles ended up in the finished food product. Since glass contamination could cause severe injury to the consumer, it is a physical foreign material classified as a food safety issue.

> A small plastic piece for a plastic ingredient bag was inadvertently added when ingredients were dumped from the bag into a blender. Since the plastic piece is not likely to cause injury, but would be detected by the consumer and result in a foreign material complaint, it is a physical foreign material classified as a quality concern.

This chapter focuses on the control of physical material such as wood, glass, metal, plastic, rock, or bone that may come from equipment, buildings, and raw materials or ingredients. Personal sources of physical foreign material, such as hair, jewelry, false eyelashes, or fingernails are addressed in the Personnel Practices Chapter.

Food products are derived from raw agricultural products which may contain certain physical foreign material or defects that will not cause harm and are unavoidable, e.g., hair or insect fragments. However, control of this foreign material is important so it does not cause the food to be unacceptable. The Food and Drug Administration recognizes these defects and believes a person engaged in food production should have a good understanding of food safety principles related to the type of production involved.

Defect Action Levels

The Good Manufacturing Practices (21 CFR, Section 110.110) recognizes there are "natural or unavoidable defects in food for human use that present no health hazard." Defect action levels are established for foods whenever it is necessary and practical to do so. These levels are subject to change upon the development of new technology or the availability of new information. Compliance with defect action levels does not excuse violations of the requirements. Evidence indicating that a violation exists causes the food to be considered adulterated, even though the amounts of natural or unavoidable defects are lower than the currently established defect action levels. Manufacturers, distributors, and holders of food are to use quality control operations that reduce natural or unavoidable defects to the lowest level currently feasible at all times. In addition, mixing a food containing defects above the current defect action level with another lot of food is not permitted and causes the final food to be considered adulterated, regardless of the defect level of the final food.

Visual Inspection of Shipping/Receiving Vehicles

The first step in managing foreign material in a food product is to ensure ingredients and raw materials are free of contamination when they are received. This expectation must be conveyed to suppliers and should be part of the supplier approval process and agreements. Provisions should be made if a supplier fails to meet

this standard. However, this does not exempt manufacturers from the responsibility to ensure their ingredients and raw materials are free of foreign material.

Visual inspection is important to identify any potential physical foreign material that may be associated with the vehicle or the materials. Designated employees should be appropriately trained to conduct these examinations and have the proper tools needed to conduct the exam. These tools may include a flashlight, inspection mirror, thermometer, scraper, etc. A digital camera may also be a valuable tool to document specific findings in order to report back to the supplier or transportation firm.

Safety requirements should be considered for those conducting bulk vehicle inspections. Employees may need to access the top of bulk vehicles to verify security seals and inspect the condition of hatches and the interior of the vehicle.

Visual inspection of transportation vehicle, such as trucks, trailers, and railcars may identify possible sources of physical foreign materials that could have been introduced during the loading/unloading process. Damaged wood sidewalls on trucks and trailers could lead to the inclusion of wood splinters that may pierce the packaging material as pallets of goods are removed or repositioned. These vehicles should also be inspected for the presence of unprotected or broken lights. Some of these vehicles have lighting mounted in the tops or on the sides of the vehicles. If the glass bulbs are damaged during transportation, particles of glass may be on top of or within the pallets. If these conditions exist, they should be documented and reported to determine if the load will be accepted or rejected.

Bulk shipping trailers and railcars also have potential sources of physical foreign material. The interior of these vehicles could be rusty or have deteriorating linings. Interior vehicle inspections should be done before and after unloading materials and prior to loading. It may be difficult to determine the condition of a vehicle's interior when fully loaded, but easier once unloaded. A good flashlight or inspection light should be used.

Hatches, ports, or connection points on these vehicles should also be thoroughly inspected. Some of these items may have a gasketing material. If the gaskets are deteriorating, it could lead to pieces of rubber being included in the ingredients. All transfer hoses or piping used to load or unload materials should also be thoroughly inspected to ensure they are in proper condition and free of physical foreign material.

Additional information about incoming material inspections is available in the Transportation and Storage Chapter.

Sampling and Examination of Ingredients/Raw Materials

Samples of finely ground materials, such as bulk flour, sugar, and salt are typically taken for quality purposes, but they may also be used to detect the presence of foreign materials. An appropriate statistical sampling plan should be developed for bulk ingredients to determine the proper amount of materials to collect. These samples should then be passed through an appropriately-sized screen. For example, flour sifter screens should be at least a 30-mesh (600 micron). It may also be important to physically sort through and look for any physical foreign material, using a flashlight to help identify shiny pieces like glass fragments.

Large particle ingredients, such as whole wheat, raisins, nuts, fruits, etc. should be partially sifted, if possible. A statistical sampling plan should be developed for these materials. Once the samples are collected, as much of the material as possible should be passed

through a screen. Sometimes sifting is not possible for large particle ingredients. The remaining sample that cannot pass through the screen should be spread out on a large sheet of white paper to examine for signs of physical foreign material. A good light or flashlight should also be used to conduct these inspections.

It may be beneficial to pass samples of both finely ground ingredients and large particle ingredients through a magnet to determine if they contain any ferrous metals.

A statistical sampling plan should also be in place for liquid ingredients and samples collected. Depending on the ingredient, the physical material check may require the use of a strainer, magnet, flashlight, or other devices to help determine if any physical foreign material is present in the samples.

In all cases of visual ingredient sampling, the likely foreign material findings include insects, rodent excreta, hairs, glass, plastic, rocks, rubber, etc. The type of item will vary with the ingredient being examined.

An adequate visual examination record should be maintained to document that the inspection was completed. Any physical foreign material findings and corrective actions taken should be recorded. These records should be reviewed periodically to determine if any trends are developing with a specific supplier or raw material.

Glass, Brittle Plastics, and Ceramics Program

The goal of a glass, brittle plastics, and ceramics (GBPC) program is to eliminate all non-essential GBPC and provide protection and inspection of any essential GBPC within the facility and procedures for cleaning up any breakage.

Glass is one of the more serious physical foreign materials in food facilities. There are few detection devices that will identify and remove glass particles within a food product. Glass can cause consumer injuries, from cutting the mouth or causing severe internal damage inside the digestive tract leading to internal bleeding or secondary infections.

Like glass, brittle plastics and ceramics can have the same injurious effect. Brittle plastic is any plastic that is capable of shattering. It is made of acrylic and goes by some common names such as Plexiglas and Lucite. Acrylic is considered brittle since it breaks into pieces when subjected to blows beyond its impact resistance. Non-brittle plastics can be made of polycarbonate or other soft plastic such as Ultra High Molecular Weight (UHMW). Polycarbonate plastics marketed under brand names such as Lexan, Tuffak, Zelux, Cyrolon, and Cryoflex are not considered to be brittle since they have high-impact resistance. However, regardless of the type of material, all plastics should be monitored for wear, damage, or defect to prevent the inclusion of physical foreign material.

Ceramics are not commonly found in today's food facilities, but some sources remain (e.g., thermocouples and magnets). Ceramic (ferrite) magnets are very hard and brittle. These magnets are particularly prone to cracking when the application involves impact or flexing. As with most ceramic, ferrite magnets should not be exposed to heating or cooling rates greater than 200°F/93°C per hour. Damage to these magnets may create a physical foreign material that could also lead to injury.

Glass control is addressed in US food regulations in 21 CFR Part 110.20 - Plant Construction and Design:

> "The plant and facilities shall…provide safety-type light bulbs, fixtures, skylights, or other glass suspended over exposed food in any step of preparation or otherwise protect against food contamination in case of glass breakage."

The food industry has further strengthened their food safety

systems by including brittle plastic and ceramics.

No Non-Essential Glass, Brittle Plastics, and Ceramics Policy
The first component of the GBPC program is the establishment of a no non-essential glass, brittle plastics, and ceramics policy. The policy limits the amount of non-essential GBPC present in the facility to allow the inspection team to provide better accountability of essential GBPC locations (e.g., lighting, equipment, and tools). Non-essential GBPC may appear in personal items or in equipment or structures where other materials, such as non-brittle plastic, are easily substituted.

Personnel responsible for purchasing materials and equipment must be familiar with the GBPC program. GBPC could appear in unexpected places, such as ingredient or laboratory chemical containers, forklift headlights, picture frames, or on sanitation equipment. An evaluation for GBPC must be included in the approval process for any new items. If glass, brittle plastic, or ceramic is present, it must be determined if it is essential. If not, it should be replaced with an appropriate material. If it is essential, it must be added to the essential glass, brittle plastics, and ceramics inventory and may require special handling procedures.

Receiving personnel must be trained to inspect incoming materials and vehicles for any non-approved GBPC materials. Beyond possible concerns in the vehicles, GBPC may also be present in the goods being received.

> An equipment service provider recently returned a forklift to a food facility after repair. The receiving personnel noticed that the service provider installed a glass headlight cover on the equipment. The food safety team should be notified and they should replace the glass headlight cover with a non-brittle plastic cover.

GBPC may also be brought in by outside service contractors. These materials could include work lamps with glass bulbs, containers made of glass, tools with glass or brittle plastics, etc. Designated individuals at the facility should be responsible for inspecting items brought in by outside service contractors to ensure they are in compliance with the GBPC program.

GBPC should also be addressed in the personnel policy for personal items brought to the facility. For example, if employees must

carry lunches through product storage or production areas to reach designated break areas, glass containers may be prohibited in lunches. Vending machine items also need to be evaluated to ensure glass beverage containers do not pose a potential glass contamination issue. The policy should make an exception for eyeglasses. Although these are typically made of polycarbonate, they should be considered essential in case of breakage or loss.

Essential Glass, Brittle Plastics, and Ceramics

All GBPC that cannot be eliminated as part of the process will be considered essential and should be inventoried. The inventory should include GBPC items in structures, equipment, and utensils located in any areas where product or product packaging are stored, transferred, or processed. This includes warehouses, production areas, packaging areas, and equipment washrooms. The inventory should not include glass or brittle plastic packaging materials because they are managed differently. Once the inventory is established, it should be used to conduct monthly, or more frequent, inspections of essential GBPC that are prone to damage or breakage.

Common essential glass, brittle plastic, and ceramic items:

Overhead lights	Windows
Light covers	Gauge covers
Emergency lights	Eyeglasses
Forklift headlight bulb	Computer monitors
Ceramic tile	Electrical contacts in heat sealing equipment

When an item on the essential GBPC inventory is identified as damaged or missing, corrective action must be taken and documented. The finding may be as simple as a cracked plastic cover on a gauge, or it may be evidence that broken glass may have entered the product stream. The food safety committee or management team is responsible for determining the appropriate corrective action and recommending or implementing preventive measures. The action may not be as simple as replacing the damaged item. If there are food or materials in the area, appropriate actions are needed to ensure product contamination is prevented or handled.

There must be specific written procedures for handling essential GBPC. For example, it is accepted that light bulbs will be made of glass. Therefore, a written procedure for changing light bulbs

should be established. It should include who is authorized to change the bulbs, when the bulb can be replaced, how the bulb will be transported within the facility (preferably a protective container), and any measures needed to protect product or product areas when the bulb is replaced.

Another example of control and management of essential GBPC is handling of sampling containers. Some ingredients or products, such as concentrated oils or oleoresins, may be so corrosive they must be handled in glass. If a glass sampling container must be used, this will need to be included in the policy with specific handling instructions. These instructions should include who is authorized to handle the glass while in product areas, traffic patterns to follow, and a description of how the glass will be handled, carried, and stored such as keeping it in a protective container until the time of use.

A timely and effective response to GBPC breakage is critical to ensure that no potentially contaminated product reaches consumers. There should be a written procedure outlining how to respond to breakage, clean the area, dispose of broken materials, and handle suspect product.

First, the area should be quarantined to prevent broken materials from spreading to other areas. Cones or hazard tape can be used to restrict traffic in the area. If breakage occurs in a production or storage area, all equipment and materials should be kept in the area for further inspection.

The procedure must specify that any affected ingredients, finished products, packaging, or other materials, including those previously produced that could have been jeopardized, must be discarded and logged in the inventory control system. A record of disposal must be kept.

All equipment and areas where the breakage has occurred must be cleaned to remove any debris. The tools and materials to be used for the cleanup, including brooms, brushes, dust pans, and trash containers, should be specified in the procedure. It may be best to have designated tools for breakage cleanup. In most scenarios,

these cleaning tools should be disposed of after cleaning to prevent further spread of the broken pieces to other areas of the facility. At least two cleanup kits should be maintained in case the first cleanup was not detailed enough and additional broken materials are noted after the initial cleanup has been completed.

A detailed post-cleanup inspection should be conducted using effective flashlights. Shining the flashlights at an angle across affected and nearby surfaces will help identify any remaining broken pieces. Once the area is free of broken pieces, a thorough cleaning or sanitation cycle should be conducted as specified for the area. After this is completed, one final post-operational sanitation review should be conducted to ensure all broken pieces are removed, designated breakage cleanup tools are removed and disposed of, if necessary, and all pieces and trash containers are removed from the area and discarded.

Safety requirements for the employees cleaning the area, including the use of safety gloves, should be determined to prevent any cuts or other injuries.

Glass Packaging

Facilities that package product into glass containers, such as jars and bottles, must have additional controls in their GBPC program specifically for these containers. The first control is to eliminate any slivers or fragments that may be present in the containers due to transport and handling prior to filling. This typically involves inverting the container and washing it with either compressed air or water. More detail on bottle washing is provided in the physical foreign material control devices section of this chapter.

A procedure must also be in place for handling breakage on the line before, during, and after packing product in glass containers. When

breakage occurs, all containers before and after a predetermined distance on the line should be cleared from the line and properly disposed of. The distance must be verified to ensure any potentially affected containers are removed from the line. Removal of product that was capped or otherwise sealed at the time of breakage is probably not necessary. However, the plant must assess the potential for glass slivers to be on the packaged product.

If breakage occurs at the filler, it may be necessary to clean the filler head(s). Removed containers may be recleaned and reused if the cleaning process is determined to be effective. However, any product that was present in the filler or in open containers cannot be reworked.

The last control measure for glass packaging containers is to store them in a segregated area that does not have the potential to contaminate ingredients if there is breakage prior to or after receiving. Signs that indicate the area is designated for glass storage are advised.

Metal-to-Metal Program

Metal is another common physical foreign material in the food industry. Much of the equipment used in the food industry is constructed of metal. Some of this equipment may wear over time due to abrasion from the ingredients or product, metal-to-metal wear, or simply become damaged from fatigue or stress. It is imperative that food companies establish a metal-to-metal program.

Equipment Design

Raw materials, ingredients, and products may be abrasive by nature, causing metal surfaces to wear over time. This wear typically does not create a food safety concern because the metal is a minuscule particle or dust which is usually not detected by electronic metal detection equipment, may be removed by magnets in the process, and is generally undetected by consumers. However, over time some of this abrasion may create holes in the metal surfaces and allow pieces to become dislodged or end up in the product. It is important that proper design considerations be made for the equipment and appropriate materials provided to withstand the abrasion of the materials. Monitoring these wear points is an important part of the preventive maintenance program to determine when equipment will need to be replaced to prevent metal foreign material issues from developing.

Equipment may also have metal-to-metal contact points which can create wear over time. Efforts should be made to minimize these metal-to-metal points. They can be designed out of the process or other appropriate materials that will not create significant stress or wear of the equipment can be chosen. For example, plastic scrapers on mixing paddles inside of a mixing vessel can be used instead to prevent metal-to-metal contact between the metal paddles and the container.

It may also be necessary to design equipment with appropriate metals that can be captured by a magnet or readily detected by electronic detectors. Various metals have magnetic properties and are more readily captured by a magnet if one is used in the process. Some metals are also rather difficult for electronic metal detectors to identify and should be avoided when possible.

> Metal screens with magnetic properties are used so that if the screen breaks or tears, the fine pieces of wire may be captured by a magnet located after the screen in the process.

Inspections

Locations where there is the potential for metal-to-metal contact throughout the plant should be inventoried. To determine these locations, equipment should be scrutinized, paying close attention to moving parts. Prior issues are also a good indicator of areas to include on the inventory. Foreign material control device findings, such as magnets and electronic metal detectors, should also be used to identify locations of concern. Once these areas have been identified, a list of these metal-to-

Examples of areas to include on the metal-to-metal inventory:

An agitator shaft that passes through a mixer lid
A mixer paddle
A screw auger
A metal conveyor belt or band

metal contact areas should be documented for routine inspection. The complete inventory may be identified with a list, a map, photographs, or a combination of these tools so that personnel performing the inspections know exactly what needs to be examined. The food safety team should determine the frequency of inspection depending on risk. A high-risk area may be inspected daily, while a lower risk area may be inspected monthly. The inspections may reveal actual wear or alignment issues that precede wear. Evidence of wear includes gouging, rough spots, the presence of metal dust, or shiny spots on the metal. All findings must be documented and immediately reported for corrective action.

Corrective Action

Once metal-to-metal wear has occurred or is imminent, short-term and long-term corrective actions are needed. Short-term measures may include repairing the equipment and placing suspect product on hold. Long-term corrective action will include measures to prevent recurrence by either controlling the issue (e.g., more frequent preventive maintenance) or by eliminating the issue (e.g., reengineering the area to prevent the potential for wear).

All short-term and long-term corrective actions must be documented. Recurring findings at a particular location indicate that the long-term corrective action was not effective and a different corrective action must be implemented. A review of prior actions is needed to ensure that the same mistake is not repeated.

Wood Control Program

Overall, the use of wood in food manufacturing facilities has significantly decreased. Wood is generally discouraged as it may crack over time and create optimal conditions for insects or microbiological organisms, it may become a physical foreign material concern if it breaks or splinters, and because it is porous and not suitable to wet wash environments. However, the use of wood still has some applications in various sectors of the food industry, including wood equipment in the milling industry or wooden pallets. When wood is used, a program should be in place to monitor the condition and provide appropriate repairs or corrective actions.

Wood Reduction

Many food manufacturing companies have eliminated wooden equipment, tables, wooden handles on maintenance or cleaning utensils, and other non-essential wood. Some have also eliminated the use of wooden pallets in production areas. Whatever measures your company takes, a program should be in place to monitor for the presence of wood and determine if alternatives are available.

The purchase of wooden handled utensils can be restricted or eliminated since they can become damaged or break, creating splinters. Purchasing personnel should be encouraged to search for alternatives, such as plastic or metal handled utensils. Someone should also monitor contractors' utensils to determine if they contain wood and will be a concern in the areas where they will be used.

Some companies have chosen to restrict all wooden pallets from production areas by transferring all materials on wood pallets to a plastic or other non-wood pallet prior to them being brought into production areas. A pallet inverter is commonly used in these situations.

Pallet Inspection Program

Facilities that still use wood pallets need a detailed pallet inspection program that includes the pallet condition and corrective action taken if damage or splinters are a concern. When items are received on wooden pallets, the supplier should be notified of any identified issues. The goal is to challenge the supplier to thoroughly inspect the pallets before materials are placed on them. If empty pallets are received, a detailed inspection should be conducted to evaluate the condition. Pallets in poor repair or condition should be rejected from the load and appropriately removed from the facility and sent back to the pallet supplier.

The pallet inspection program can be included in the receiving protocol and inspection program. Detailed work instructions should be written to remind employees of the importance of inspecting the condition of the pallets upon arrival. Packaging personnel should also inspect pallets as they are placed on palletizing equipment or used in packaging areas. Any discrepancies should be appropriately documented and corrective action provided.

Physical Foreign Material Control Devices

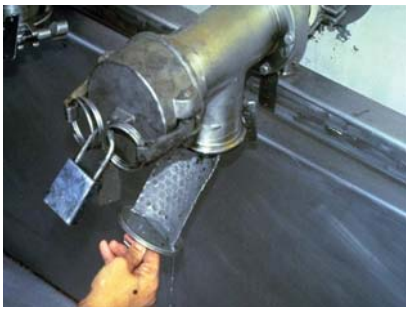
There are many types of physical foreign material control devices used in the food industry. Appropriate devices should be installed at necessary locations depending on the type of products being produced.

Sifters

Sifters are used for dry, milled, or powdered ingredients and finished products. The size of the sifter screen depends on the ingredient or product ran through the device. It is important to provide sifters on bulk raw materials prior to their introduction into the process and at the completion of the process before packaging or loading into bulk transfer vehicles. Sifters are typically equipped with a tailings container to collect the foreign material removed from the system. The tailings containers should be inspected regularly to monitor possible foreign material and an investigation conducted for unusual findings.

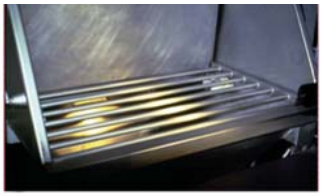
Sifter screens are typically constructed of metal wire mesh, perforated plates, or other fabrics, such as nylon. All sifter screens have the potential to become damaged, some more than others, through normal use of the equipment. Sifter screens should be inspected regularly to monitor for tears, holes, defects, wear, etc. It is generally recommended to inspect these screens at least weekly. The results of the inspections should be documented and appropriate corrective action taken if any discrepancies are noted. Corrective action may require screen replacement, as well as an evaluation of the product produced since the last successful check. Damage to the sifter screen may result in foreign material contamination from the screen material itself.

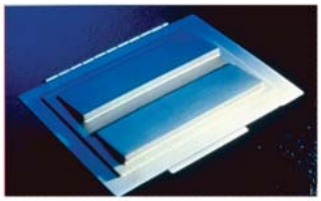
Strainers



Strainers can be used for liquid ingredients and finished products. Strainers are typically installed at the point of receipt for bulk liquid ingredients to monitor for foreign material prior to entering a bulk storage system. These devices should be inspected before and after unloading the bulk ingredients. It may also be necessary to install strainers within the process where liquid ingredients are added for additional monitoring. The size of the strainers will depend on the type and viscosity of the materials.

Magnets





Magnets are commonly used to remove magnetic metals from incoming ingredients, to protect sensitive equipment (e.g., grinding units that may be damaged by stray metal), and as a final check of finished products before packaging. There are several magnet equipment systems available depending on the type of product.

All magnets should be inspected and cleaned regularly to monitor for unwanted metal contaminants. Magnet findings should be documented and the process or equipment inspected if unusual findings are found on the magnets.

The condition of the magnet can also be monitored by conducting periodic pull-strength tests to ensure the magnet is maintaining an appropriate level of pull. A schedule of these tests should be established and the results documented and compared to an established standard of strength for the specific magnet. If the results are outside of an accepted standard, corrective action should be provided. Pull-strength test kits are available from most magnet manufacturers.

Metal Detectors

Metal detection devices are typically located in finished product packaging areas. However, some are installed to monitor incoming sensitive bulk materials or located just prior to sensitive equipment, such as hammer mills or grinders. The purpose of these devices is to monitor the final products for possible metal foreign material prior to or after packaging, depending on the product.

Metal detectors can generally recognize ferrous metals the easiest as they have the greatest amount of conductivity, thus causing the most disruption in the metal detector. The most difficult type of metal to detect is stainless steel, which has far less conductivity and causes less disruption.

A detailed program is needed to monitor and inspect metal detectors. For finished product metal detectors, the frequency is generally determined by the amount of product that would be manageable for reinspection, rework, or disposal. Metal detectors are generally checked by passing a series of test pieces through the head of the aperture to determine if it is capable of detecting the size of the test piece. These tests should be conducted prior to the start of production, at established intervals, during changeover, other disruptions, and at the finish of packaging.

Metal detectors also use a reject mechanism that is integrated into the system. If the metal detector unit detects a foreign object, the reject device will remove that specific unit passing through the system. These reject devices may use a stop-belt mechanism, air rejection, conveyor retraction, physical rejection, or other method to remove the specific unit of product in question.

Any units of product rejected from the metal detectors should be thoroughly inspected to determine the foreign material and its possible source. All rejects and findings should be appropriately documented and corrective action provided.

X-ray

X-ray inspection technology offers contamination detection for several materials, including glass, metal, stone, high-density plastics, and products packaged in foil or metallized film. X-ray systems can also perform a wide range of inline quality checks such as measuring mass, counting components, identifying missing or broken products, monitoring fill levels, inspecting seal integrity, and checking for damaged packaging.

X-rays are an invisible form of electromagnetic radiation-like radio waves. Their short wavelength allows them to pass through materials that are opaque to visible light. But they don't pass through all materials with the same ease. In general, the denser the material, the fewer x-rays that pass through. Hidden contaminants, like glass and metal, show up under x-ray inspection because they absorb more x-rays than the surrounding product. An x-ray device is essentially a scanning system that accepts or rejects the image. If rejected, a rejection signal is sent and the product is removed from the production line.

There are many x-ray inspection technology providers. Similar to metal detection, appropriate calibration and checks must be conducted to ensure units are functioning properly. An experienced representative should assist a food company in evaluating appropriate x-ray inspection devices and establishing a program to maintain, check, and document their performance.

Bottle Washers or Can Cleaners

Bottle washers or can cleaners can be used to eliminate any physical foreign materials that may be present in containers due to transport and handling prior to filling. This typically involves inverting containers and washing them with either compressed air or water. The correct pressure of air or water must be validated and routine

monitoring of the pressure and nozzle alignment should be conducted and documented. If the pressure or alignment does not meet established requirements, the containers must be considered suspect.

These devices will generally have a screen or basket located below them to collect any physical foreign materials that have been removed. Findings should be examined during routine checks to determine what type of foreign material is in the containers and an investigation conducted to determine the source of the materials.

Optical or Laser Sorters

Optical or laser sorters detect and remove foreign bodies as well as defective, undesirable, or contaminated product from good product streams on differences in color, texture, structure, shape, density, or any combination thereof. These devices are commonly used in food facilities that handle fruits, vegetables, peanuts, tree nuts, etc.

These devices are typically located to monitor raw incoming materials and remove natural defects from harvested foods, such as decomposed or bruised product, stems, leaves, etc. The sorters are set to detect differences from the acceptable materials being received. An air blast or small mechanical devices are used to remove the defective products from those that are acceptable.

Other Devices

Other less common devices may also be used to remove physical foreign material, including gravity tables, bone removal equipment, sieves, destoners, and aspiration. Each facility will have to determine the appropriate types of devices necessary to remove physical materials that may lead to food safety issues or customer complaints.

Employee Awareness

Employees should be trained and educated on the importance of monitoring their respective work areas, equipment, and processes for any potential physical foreign material concerns. An example of this may be an employee working in a production area where conveyor belts are used. There may be concern for deterioration of the belt with fraying, damaged flights on the belts, damaged side rails, etc. Employees should be encouraged to immediately report these conditions to supervisors and ensure appropriate corrective actions are taken.

Physical Foreign Material Control Reference Card

Use this Physical Foreign Material Control Reference Card as you contribute to your company's physical foreign material control program. When you are ready, proceed to the workshops to apply what you have learned to real-life situations.

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Physical Foreign Material Control

Reference Card

Physical Foreign Material

- Contaminant or adulterant
- Wood, glass, metal, plastic, rubber, bone, rock, hair, jewelry, false fingernails or eyelashes, etc.

Adulterant

- Makes food impure
- May not necessarily cause injury or illness

Contaminant

- Is an adulterant
- Would cause injury, illness, or death

Defect Action Levels

- Natural or unavoidable defects in food that present no health hazard to humans
- Should try to reduce natural defects to lowest level feasible
- Mixing foods to get below defect action levels is prohibited

Shipping/Receiving Vehicles

Visual examination of vehicles

- Trained individuals to examine vehicles
- Inspection of bulk and non-bulk vehicles
- Examination of hatches, ports, unloading hoses, etc.
- Maintaining records of examination

Sampling and examination

- Statistical sampling plan
- Sifting finely ground materials
- Use of strainers and magnets for liquids
- Maintaining records of examination

Glass, Brittle Plastics, and Ceramics (GBPC) Program

- Materials can cause severe injury
- Eliminate all non-essential GBPC
- Inventory of all essential GBPC
- Inspect GBPC inventory
- Breakage and cleanup procedure for GBPC

Metal-to-Metal Program

- Proper design of equipment
- Metal-to-metal inspections
- Corrective action for metal-to-metal contact

Wood Control Program

- Eliminate non-essential wood
- Pallet inspection program

Physical Foreign Material Control Devices

- Sifters – dry, milled, or powdered materials
- Strainers – liquid materials
- Magnets – removal of magnetic metals
- Metal detectors – monitor for presence of metals
- X-ray inspection – may detect various physical foreign material
- Bottle washers and can cleaners – clean interior of container prior to filling
- Optical or laser sorters – remove foreign bodies
- Other devices, as appropriate

All physical foreign material in a food product is considered an adulterant, but not all materials are contaminants (cause illness, injury, or death). Which of these items are contaminants?

Glass shards	
Brittle plastic pieces	
Small piece of duct tape	
Metal shavings	
False eyelash	
Flour beetle	
Wood splinters	
Small screw	
Strand of hair from employee	
Wire clipping from electrical wire	
Piece of plastic handle	
Small piece of paper from ingredient bag	
Bristle from a cleaning brush	
Sliver of bone in boneless chicken breast	

Answer the following questions about this bulk liquid tanker trailer.

1) What are two possible physical foreign material issues you may identify upon inspecting the top hatch of the trailer before and after unloading?

2) The hose used for unloading is transported on the trailer in a compartment (pipe) and then hooked up for unloading the liquids. What are two possible physical foreign material issues with the hose, storage compartment, or connection port you may identify before connecting the hose to the trailer and building?

The following items may be considered non-essential glass that could be otherwise protected or replaced with a non-brittle plastic. Describe how they could be replaced with a non-brittle plastic or otherwise protected.

Glass headlamp cover on a forklift

Glass emergency light

Glass computer monitor

Exposed fluorescent bulbs in the ceiling of a production area

Glass bulb inside of an electric insect light trap

Glass picture frame on the quality policy that is displayed in the production area

Broken Glass Cleanup Workshop

During production, an employee reports evidence of a broken light bulb on the floor near a pallet of staged ingredients in the production area. Arrange the following actions in the appropriate order to handle the breakage and cleanup.

__ Remove and discard all affected products and ingredients, including those previously produced that could have been jeopardized

__ Stop production

__ Document the cleanup of this area and what was done with all affected products and ingredients

__ Gather appropriate cleanup tools and materials

__ Quarantine the area

__ Conduct an inspection with a flashlight to ensure all glass has been removed

__ Thoroughly clean the area to remove any broken glass

Physical Foreign Material Devices Workshop

Select the types of physical foreign material each device would most likely identify or remove from ingredients or products.

Magnets

Glass	
Plastic	
Wood	
Metal	
Paper	
Insects	

Strainers

Glass	
Plastic	
Wood	
Metal	
Paper	
Insects	

Bottle Washers or Can Cleaners

Glass	
Plastic	
Wood	
Metal	
Paper	
Insects	

Sifters

Glass	
Plastic	
Wood	
Metal	
Paper	
Insects	

Metal Detectors

Glass	
Plastic	
Wood	
Metal	
Paper	
Insects	