Preharvest HACCP in the Table Egg Industry

Hazard Analysis Critical Control Point System for Enhancing Food Safety
Foreword

This manual provides educational support for the Pennsylvania Egg Quality Assurance Program certification training and enhancing food safety in the table egg industry. Those who want to improve the safety of the eggs they produce are encouraged to adopt the practices outlined in this manual. The U.S. Department of Agriculture endorses the farm-to-table Hazard Analysis Critical Control Point (HACCP) system as the best science-based approach aimed at pathogen reduction. Voluntary participation in HACCP-type programs reduces the risk of marketing eggs contaminated with Salmonella enteritidis and maintains consumer confidence in eggs and egg products.
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Introduction

Salmonella contamination is the leading cause of foodborne illness in the United States. Responsibility for the wholesomeness and quality of animal foods once rested with the USDA inspection system, but today, we realize this is only one part of quality assurance. In order to control salmonella, new programs must be adopted at all stages of production, processing, and preparation of foods. The poultry industry and egg handlers must work together to ensure that the chain of bacteria reduction and quality assurance is not broken.

Salmonella are a family of bacteria known as *Enterobacteriaceae*, which are found in the intestinal tract of humans and other animals. More than 2,300 types of Salmonella are known to exist. *Salmonella enteritidis*, or SE, is just one of these types, but one that is predominantly found in poultry products including fresh shell eggs and unpasteurized liquid eggs. SE from feces can contaminate eggshells, while hens with whole body infections can contaminate egg contents. People can contract salmonellosis from consuming contaminated eggs, egg products, poultry, or meat products that have not been properly cooked. Unfortunately, a contaminated utensil or food handler can recontaminate a properly prepared food that was free of SE. Clinical signs of salmonellosis appear 12 to 72 hours after eating the contaminated food and include acute gastroenteritis, fever, headache, abdominal cramps, nausea, vomiting, and diarrhea. Severity of the disease is usually proportional to the number of organisms that enter the body. Therefore, any procedure that reduces the number of SE organisms in food will reduce the risks of salmonellosis.

Past efforts to control SE have been largely reactive and have not succeeded in preventing contamination of eggs. Currently, hens or eggs that test positive for SE are diverted to processing plants, where the bacteria are destroyed by thermal processes. Unfortunately, egg production environments cannot be made sterile, and only a small fraction of poultry houses, hens, and eggs can actually be tested. For these reasons, it is virtually impossible to produce eggs with complete assurance that they are free of SE bacteria. Therefore, efforts to control SE need to be proactive, focusing on risk reduction and prevention. Food safety experts from universities, government, and the food industry agree that the best food safety system available for preventing foodborne illness is the Hazard Analysis Critical Control Point (HACCP) system.

HACCP is a science-based system that identifies and monitors critical control points (CCP) throughout the food chain in order to reduce or eliminate hazards. This manual will address the seven steps of the HACCP system for risk reduction:

1. Assess the hazards.
2. Identify CCPs.
3. Establish critical limits for each CCP.
4. Monitor CCPs.
5. Take corrective actions.
6. Set up a record-keeping system.
7. Verify that the HACCP system is working.
This manual covers the three hazards identified by the 1995 Pennsylvania SE Pilot Study as significant risk factors for contaminating eggs with SE. The hazards are SE-contaminated poultry houses, rodents, and pullet chicks. Today in Pennsylvania most eggs are produced under the Pennsylvania Egg Quality Assurance Program (PEQAP), which emphasizes three CCPs including cleaning and disinfecting pullet and hen houses between flocks, rodent control, and placing SE-clean chicks in the pullet house. The PEQAP is a HACCP-type program monitored and supported by the Pennsylvania Department of Agriculture (Figure 1).

All people involved in production, procurement, and processing need to realize that eggs must be treated as a food, not just a commodity. Commitment to the egg industry HACCP system means everyone is responsible for egg safety, from the person servicing breeder flocks to the parent preparing egg dishes for the family (Figure 2). Although HACCP-type programs can not guarantee shell eggs to be free of SE contamination, it will assure the public that egg producers are taking every precaution to maintain the safety of their eggs.
Biosecurity Risk Factors

Biosecurity involves using all measures possible to control the spread of disease-causing organisms such as *Salmonella enteritidis* (SE). These measures include controlling human traffic, isolating poultry from contaminated equipment and animals, controlling insects and rodents, vaccination, disinfection, and good housekeeping. The goal of biosecurity is to keep disease-causing organisms from your birds. These tiny microbes travel from place to place in manure, dust, and feathers, carried by air and on people, equipment, vehicles, animals, and other birds. Therefore, the greatest risk factors for introducing disease-causing organisms are contaminated people, equipment, and animals. The best management practices (BMPs) of a good biosecurity system are listed below.

### BMPs for People

1. Make sure employees and family members wear freshly laundered clothing daily.
2. Have all visitors report to a central location and sign a log book before entering any building.
3. Do not allow anyone, including maintenance personnel and pest control people, to enter your poultry house or egg room unless they are wearing clean and sanitized coveralls, boots, and hat (Figure 3).
4. Clean and disinfect boots before entering and leaving each poultry house. Manure is a major factor responsible for the spread of disease from one poultry house to another. If you have more than one poultry house on your farm, you may want to consider having a separate pair of boots for each house. By storing the boots in a rubber garbage can, you can keep them in wearable condition. This practice would be especially helpful if you have poultry of different ages on the farm.
5. Change water in foot baths and add disinfectant at least daily, or more often if baths collect a lot of dirt and manure.
6. Always shower and change into clean clothes before leaving your farm and after returning home. This practice will help prevent the spread of any disease from one farm to another. You can pick up disease organisms by visiting other farms, auctions, meetings, or restaurants where other farmers, service people, or backyard flock owners visit. By showering and changing into clean clothes when you return home, you are taking a big step toward reducing the spread of disease organisms.
7. If possible, try to limit each person’s work schedule to one poultry house.
8. Do not visit younger birds after visiting older birds except when younger birds are positive for SE or other diseases. If you must visit older birds first, be sure to shower and/or change clothes before visiting younger birds.
9. Keep all buildings locked at all times to ensure that your biosecurity plan is followed by all visitors and nonfarm employees (Figure 4).
BMPs for Equipment

1. Borrow equipment from another farm only if it is thoroughly cleaned and disinfected (Figure 5).
2. Restrict movement of all vehicles entering and leaving your farm. Have vehicles park outside the premises whenever possible.
3. Bring onto the farm only clean and disinfected crates, egg cartons, etc. Reject anything that is not clean and notify the supplier of the problem.
4. Do business only with companies that have high biosecurity standards.

BMPs for Animals

1. Avoid contact with wild birds and waterfowl.
2. Always place new birds in a clean and disinfected house. (See Clean and Disinfect Between Flocks: #1 CCP for procedures.)
3. Control rodents and insects inside and around poultry houses. (See Control Rodents: #2 CCP for procedures.)
4. Properly dispose of dead birds in a timely fashion.
5. Make sure poultry houses are properly ventilated. Large amounts of fresh air dilute microbe populations and reduce disease buildup.
6. Keep manure as dry as possible.

Assign a person to monitor your biosecurity program. Have all visitors sign a log book. The book should request the date, time, person’s name, reason for visit, and names of other poultry farms visited before arriving at your farm. Keep all log book entries for at least 3 years as part of your biosecurity records. Have a second sign-in sheet for each poultry house. The sheet should request the date, time, person’s name, and reason for entering the building. File house sign-in sheets monthly and keep entries for at least 2 years.

The success of your biosecurity program depends on you. Do not allow any exceptions! The goal of biosecurity is to keep germs away from your birds and your birds away from germs.

REFERENCES


Clean and Disinfect Between Flocks

#1 CRITICAL CONTROL POINT

Organic material can harbor bacteria such as *Salmonella enteritidis* (SE). The goal of cleaning and disinfection is to reduce the organic material and bacteria in the environment, thereby reducing the risk of SE contamination.

“Down time” between the removal of one flock and the placement of the next allows for thorough cleaning, disinfecting, drying, and inspecting the house. Allow at least 2 weeks between flocks. When turnover is too quick, birds may be placed in a house that is still damp and may not be clean.

**Dry Clean**

1. Remove all birds, eggs (broken or not), and other live creatures including cats, wild birds, and rodents. (See Control Rodents: #2 CCP for procedures.)

2. Thoroughly dry clean the house (Figure 6).
   - Use compressed air to clean air inlets both inside and out.
   - Blow dust and loose debris into the pit.
   - Clean manure off cage cross members and floor joists.
   - Run the manure scraper as low as possible or knock manure off cage curtains.
   - Clean fan housings, brush blades, and louvers.

   • Remove all manure and debris from the pit.
   • Remove all mobile equipment from the house, the egg room, and the workroom area.

3. If particular areas have not been cleaned properly, reclean them prior to washing down.

**Wash**

1. Wash down the house (Figure 7).
   - Wet down all dirty areas and allow time to soak.
   - Wash all surfaces and equipment using high pressure (1,500 psi and above).
   - Heat the house during winter wash-downs (the warmer the better).
   - Give special attention to air inlets, both inside and outside.
   - Wash the upper portion of the house first and then the pit.
   - Push water out of the pit each day after washing.
   - Run feeders each day after washing and before washing the floors.

2. If particular areas have not been washed properly, rewash those areas prior to disinfection.
Disinfect

1. Apply disinfectant to all surfaces as a spray or foam, treating the upper portion of the house first, then the pit (Figure 8).
   - Phenols and quaternary ammonium (quats) products are suggested disinfectants. Phenolic compounds are used most often because they are more active in the presence of organic material than other disinfectants such as quats.
   - Chlorine compounds can be effective, but they are readily inactivated when they come in contact with organic material.
   - Surfaces always should be free of organic material for the disinfectant to be effective.
   - Any products used in conjunction with each other must be checked for compatibility.
   - Follow all directions on product labels.

2. If particular areas have not been disinfected properly, disinfect again prior to culturing.

3. Clean the following by hand or using low pressure (600 to 800 psi):
   - electrical equipment
   - egg room and workroom
   - farm packer
   - egg grader
   - egg cooler
   - office
   - bathroom
   - stairs and walkway to pit

4. Designate a specific person to monitor the cleaning and disinfection (Evaluation Form, Appendix A), and to keep records and review the records, critical limits, and microbial sampling and analysis to verify the HACCP plan is working. If any areas evaluated in Appendix A have greater than “none or slight” organic matter, reclean and disinfect those areas prior to culturing.

5. Culture the environment after cleaning and disinfection (Figure 9). (See Appendix B for procedures.)

6. Reclean and disinfect specific areas if culturing results suggest more effort is needed.

7. Once a new flock is placed, keep the house as clean as possible. Clean the packer, egg room, and bathroom daily. Remove egg material and soil from cross conveyor rods twice weekly and dispose of broken eggs properly. Keep eggs and feed off the floor and out of the manure pit. Do some dry cleaning as needed to maintain fan efficiency and inlet capacity.
Rodents are a significant source of *Salmonella enteritidis* (SE) exposure for chickens. A single mouse produces 100 droppings a day and each can contain up to 230,000 SE bacteria (Figure 10). By defecating in feed troughs, on egg belts, and in other areas, rodents can spread infection throughout the chicken house and contaminate eggs.

It appears mice become infected with SE when exposed to contaminated manure. They can travel to nearby poultry houses and infect SE-negative flocks. Placement of contaminated manure or manure containing infected mice near poultry facilities provides an additional source for SE exposure.

Rodents reproduce rapidly in chicken houses where food, water, and shelter are readily available (Table 1). A few mice entering a new house can proliferate to high numbers (up to 10,000 or more) during the life of a single flock. Rodents consume food, destroy insulating materials, and undermine building structures through tunneling and nesting. A single house mouse consumes $\frac{3}{10}$ ounce of chicken feed daily, while 2,000 mice consume 25 pounds of chicken feed each day.

### Table 1. Reproductive and feeding characteristics of the house mouse (*Mus musculus*) and the Norway rat (*Rattus norvegicus*).

<table>
<thead>
<tr>
<th>CHARACTERISTICS</th>
<th>HOUSE MOUSE</th>
<th>NORWAY RAT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Home range</td>
<td>9–30 feet usually (up to 150 feet in some houses)</td>
<td>20–300 feet</td>
</tr>
<tr>
<td>Longevity</td>
<td>12–15 months</td>
<td>12–15 months</td>
</tr>
<tr>
<td>Sexual maturity</td>
<td>45 days</td>
<td>90 days</td>
</tr>
<tr>
<td>Litters per year</td>
<td>5–11</td>
<td>4–12</td>
</tr>
<tr>
<td>Young per litter</td>
<td>3–11</td>
<td>8–10</td>
</tr>
<tr>
<td>Daily feeding sites</td>
<td>many</td>
<td>usually 2</td>
</tr>
</tbody>
</table>

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**Seal Rodents Out**

1. Keep the exterior of poultry houses free of high vegetation, debris, and feed.
   - Keep all debris (old equipment, wood, cement blocks) 10 feet from the house, and mow the area regularly.
   - Establish a 3-foot section of 1- to 1½-inch-diameter crushed rock at a depth of 6 inches immediately around the building perimeter to further discourage rodent entry.
   - Clean spilled feed and dispose of cull eggs and birds appropriately to avoid attracting rodents.

2. Seal rodents out of poultry houses and destroy harborage areas within houses.
   - Make sure metal siding on the lower portion of the poultry house is securely attached to the concrete or block foundation to prevent rodent entry. Rodents can climb directly up porous concrete foundation walls, pipes, and wires. Siding on concrete buildings should begin 3 feet or higher above ground level to reduce rodent entry.
   - Building exteriors should be tightly sealed, with no gaps greater than $\frac{1}{4}$ inch.
- Drainage for the building may be constructed with large polyvinyl chloride (PVC) pipes fitted with removable screw lids or grates with openings no larger than ¼ inch.
- To ensure entrance doors and pit unloading doors close tightly, use one or more of the following:
  — mechanical door fasteners
  — improved door tracking
  — maintenance of concrete pit slabs
  — thick rubber weather stripping with a metal base (if possible) attached to the bottom of doors (Figure 11)
  — 2-x-8-inch wood board mounted inside pit load-out doors
- Holes that previously may have housed rodents infected with SE can serve as a source of infection for future rodent populations, so any previously established areas of rodent harborage inside the facility should be sealed. Materials may include concrete, mortar patch, heavy gauge sheet metal, and ¼ inch woven hardware cloth (Figure 12). Thick plastic patching and wood are less desirable but often are adequate.
- Eliminate other potential harborage sites within the house as well. Knock manure off cage support beams every 6 to 8 weeks. Remove manure from the pit whenever possible. In houses with moderate and high rodent populations, rodents may live in manure piles, and reducing their numbers is not possible without complete manure removal.

### Maintain Covered Bait Stations
1. Rodenticides (poison baits and tracking powders) often are included in rodent control programs. Rodenticides adversely affect body functions including blood clotting, the nervous system, and calcium regulation. Pellets, meals, liquids, paraffin blocks and bars, and tracking powders are available. Rodenticides are grouped into single- and multiple-dose types (Table 2). Single-dose baits require only one complete feeding, while multiple-dose baits require repeated feedings over several days to be lethal.

<table>
<thead>
<tr>
<th>ACTIVE INGREDIENT</th>
<th>SINGLE/MULTIPLE FEEDING</th>
<th>SECONDARY POISONING&lt;sup&gt;a&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brodifacoum</td>
<td>Single</td>
<td>Yes</td>
</tr>
<tr>
<td>Bromadialone</td>
<td>Single</td>
<td>Yes</td>
</tr>
<tr>
<td>Bromethalin</td>
<td>Single</td>
<td>No</td>
</tr>
<tr>
<td>Chlorophacinone</td>
<td>Single/multiple</td>
<td>Yes</td>
</tr>
<tr>
<td>Cholecalciferol</td>
<td>Single/multiple</td>
<td>No</td>
</tr>
<tr>
<td>Difenacoum</td>
<td>Single</td>
<td>Yes</td>
</tr>
<tr>
<td>Diphacinone</td>
<td>Single/multiple</td>
<td>Yes</td>
</tr>
<tr>
<td>Warfarin</td>
<td>Multiple</td>
<td>Yes (low risk)</td>
</tr>
<tr>
<td>Zinc phosphide</td>
<td>Single</td>
<td>No</td>
</tr>
</tbody>
</table>

<sup>a</sup>Secondary poisoning can occur when pets or other animals consume poisoned rodents.

**NOTE:** EPA labels state that bait must be in tamper-resistant stations or put in inaccessible areas. Workers should wear rubber or latex gloves or use long-handled bait spoons when placing bait to protect themselves and to minimize human scent at the station.
Covered bait stations are used in the most successful programs designed to control rodents. Covered stations keep bait clean and provide a secure place for rodents to feed undisturbed. In addition, they prevent exposure of bait to nontarget animals and children and help prevent contamination of feed and surfaces by the rodenticides. An inexpensive station designed for mouse control can be constructed from a section of 1½ x 12- to 18-inch PVC pipe. Commercial stations are also available. Stations with a 3-inch opening can be used where rats are the chief pest.

- Place stations along all cage row walkways at 10- to 20-foot intervals. Secure them to the wall or floor (Figure 13). For additional control, place stations around the entire pit ledge at 10- to 40-foot intervals, including fan areas in high-rise houses and at all entry or access sites to cage areas (pipes, ladders, posts, etc.). Locate stations in the walkways between houses, in utility and egg-packing rooms, and in pit entrance areas at 10- to 20-foot intervals.

- Rodents may be active year-round in the attic or may travel there during cleaning and disinfection of a facility. A trial baiting of the attic also is recommended. Place small amounts of bait at several locations above the feed equipment area for the first 20 feet of the house. Recheck the bait in 2 to 4 days. If it has been consumed, use bait more extensively.

- Where rats are the major pest, bait stations can be placed at less frequent intervals and at specific harborage or feeding sites based on their feeding patterns (Table 1). Use the Rodent Evaluation Form (Appendix C) to locate these sites.

- Wearing disposable gloves or using a long-handled spoon and following label directions, place 1 to 2 teaspoons of fresh bait in the stations every 3 to 4 weeks, or more frequently if the bait is consumed.

- Tracking powders also can be effective rodenticides. The powder gets on rodents’ feet and fur when they travel through it. During grooming, rodents ingest the powder, which contains the rodenticide. These powders can be effective when applied as a dust to holes, nesting areas, and rodenticide stations. Because a variety of safety concerns are associated with these products, they are seldom recommended in food production areas. The toxicant in tracking powders is 10 to 40 times stronger than baits and may cause contamination of the food product and handling equipment as the rodent travels through the home range.

- Over time, rodents may associate spoilage and undesirable taste or physiologic effect with a particular bait, then reject it. This is especially true for zinc phosphide. Bait shyness is not a problem with anticoagulant rodenticides. To reduce this problem, zinc phosphide baits should not be used more than twice yearly (preferably only once a year), and all baits should be kept fresh.
**Figure 14.** Store rodenticides in sealed containers in a secure area.

**Figure 15.** Insect damage can make rodenticides unattractive to rodents.

- Zinc phosphide bait should be used primarily as a “clean out” bait and is useful after flock depopulation. Bait stations should always be prebaited with some chicken feed prior to using zinc phosphide, to get rodents using the bait stations often. Prebaiting stations prior to placing the rodenticide will improve many rodent control programs. In general, baiting during clean out can be very effective due to lack of feed and harborage in manure. If solid baits are not accepted, try sweetened water baits or tracking powder prior to disinfection and wash-down. Thoroughly clean off contaminated surfaces before placing new birds.

- Store rodenticides in tightly sealed containers in a secure area away from petroleum products and other materials with odors that can be absorbed by the rodenticide (Figure 14).

- Keep an inventory of several baits containing different food base ingredients (e.g., pellets, meal, liquid, whole seed, or grain). Change bait at least every 3 to 4 weeks to keep it fresh, or more frequently as it is consumed. Change to a bait containing another active ingredient only if rodents develop bait shyness (but not more often than 1 to 2 times a year). Bait shyness or rejection is often caused by bait spoilage, especially non-parafinized baits in warm, moist climates. In some situations rodents will find some bait preparations more palatable, and it may be useful to determine “bait preference” before baiting all stations. These bait preferences can occur with baits having the same active ingredient but different formulations or preparations. Insects such as darkling beetles and fly larval stages will feed on rodenticides, making the bait unattractive to rodents (Figure 15). If this happens, change the bait and establish an appropriate insect control program.

- Relying on rodent control measures primarily at the time of farm clean-out is discouraged. It is necessary to follow a complete and comprehensive rodent control program throughout the life of the flock. Failure to do this often results in high rodent numbers while the flock is housed. If rodents are infected with SE, they will contaminate the environment (including other houses in a multiple-house complex) and may expose the flock to this bacterium.
Monitor Rodents with Rodent Indexing

Monitoring the number of rodents in a poultry house is an important part of a complete rodent control program. Rodent Indexing (RI) is an invaluable tool for monitoring rodents. RI uses both visual evaluation and 12 Tin Cat live catch mouse traps (Figure 16) to assess the relative numbers of rodents in the house and the quality of the current control program (Table 3 and Appendix D). In addition, RI is used to assess the relative risk that mice, if infected with SE, may pose to the poultry flock. High numbers of mice have been associated with SE contamination of poultry house environments in Pennsylvania.

Table 3. Rodent Indexing.

<table>
<thead>
<tr>
<th>NUMBER OF MICE CAUGHT</th>
<th>RODENT INDEX</th>
</tr>
</thead>
<tbody>
<tr>
<td>0–10</td>
<td>Low (1)</td>
</tr>
<tr>
<td>11–25</td>
<td>Moderate (2)</td>
</tr>
<tr>
<td>26 or more</td>
<td>High (3)</td>
</tr>
</tbody>
</table>

Note: Count the total mice captured in one week to determine the house’s RI based on this scale. To adjust for mice numbers caught when traps were set for periods less than or greater than 7 days (i.e., standardizes catches to a week), multiply by 7 and divide by the number of days the traps were set. Poultry farms with an RI of 3 (high) are four times more likely to have contaminated egg belts and manure than farms with an RI of 1.

1. To begin Rodent Indexing, complete the visual Rodent Evaluation Form (Appendix C) during daylight hours with the assistance of a flashlight. Using the form as a guide, place traps in areas where mice are most likely to be caught, such as along the walls of the cage walkways, pit ledges, and near fan housings. Use 12 traps in all. In a high-rise house, set a minimum of two traps in the pit. Traps placed on pit ledges can be supported by a nail driven into the ledge beneath the trap. The floor of the pit in the front of the house below the feed hoppers is frequently a good placement site. Bait the traps with an ounce of chicken feed and leave them in the house for 1 week. Check the traps twice during the week. Any trap which has not caught a mouse at the first check (2 to 5 days after traps are set) should be moved to another location where rodent harborage is evident. Traps should be moved a minimum of 15 feet. Captured mice should be humanely euthanitized.

2. The goal, or critical limit, is to maintain low mouse numbers (RI = 1). If the RI is greater than 1, reevaluate your rodent control program. Rodent Indexing should be done at least once a month for each flock. Always file the Rodent Evaluation Form for future reference, and record RI scores in the Rodent Control Log (Appendix E).

3. Visual inspection at night, shortly after dark or lights out, or in early morning using a flashlight can be effective for detecting rodents. Using a red cellophane or plastic cover over the flashlight lens is less disturbing to rodents but is not necessary. Rodents may have particular times when they are active at night, so it may be necessary to check more than once.
4. Designate a responsible person to monitor the rodent control program, keep records, and verify that the HACCP plan is working. The only effective way to monitor your rodent control program is to maintain a record of the number of rodents trapped and their activities. Appendix E contains a sample Rodent Control Log. Recording specific comments (e.g., bait consumption and rodent droppings in right rear pit area of house) allows for more detailed assessment and information necessary to adjust the control program. The log can be placed on a clipboard for the currently housed flock, and past flock records can be placed in files.

■ Verify the Program

It usually takes 2 to 8 weeks to achieve an RI in the low category in houses that have previously had moderate and high rodent populations. If you cannot answer “yes” to all of the questions below, your rodent control program may not succeed.

1. Is the exterior of the house properly maintained?
2. Are openings in doors and buildings sealed?
3. During cleaning and disinfection of the poultry house, has an honest effort been made to seal holes inside the building and intensify baiting?
4. Are bait stations placed at 10- to 20-foot intervals completely around the walls of the cage walkways?
5. Are bait stations placed at 10- to 40-foot intervals on the pit ledge and in other areas of the house?
6. If bait is being consumed by rodents, is it replaced with fresh bait at appropriate intervals in covered bait stations?
7. Is manure knocked off cage support beams every 6 to 8 weeks to dislodge potential rodent living areas?
8. Has manure been removed from the pit?
9. Has the attic been baited?
10. Has bait been checked for insect damage, which makes it unattractive to rodents?

REFERENCES


Henzler, D. J. 1993. Determining the number of mice on farms is a difficult task. Poultry Times XL(6).


Salmonella enteritidis (SE) contaminated pullet chicks are a significant hazard for the introduction of SE into laying flocks and potentially their eggs. Therefore, this critical control point, like cleaning and disinfection and controlling rodents, is essential for reducing the risk of SE exposure. Always purchase clean pullet chicks from U.S. Sanitation Monitored SE negative breeder flocks. Request documentation of breeder SE status from the hatchery supplying pullet chicks. Decline the chicks if documentation cannot be provided.

1. Monitor pullet chicks as a source of SE by sampling chick box dropping papers from every tenth box at the time chicks are delivered. Submit samples to a laboratory for SE culturing (Figure 17). See Appendix F for the sampling procedures and Appendix G for a sample submission form.

2. If the culture results are positive for SE, verify the dropping paper results, notify the hatchery, and culture the pullet house environment (Appendix H).

3. If the environment (manure) cultures are positive, take one of the following corrective actions:
   - Destroy the flock in a humane fashion.
   - Rear chicks under a vigorous SE reduction program that includes:
     - aggressive rodent control
     - weekly manure removal
     - vaccination with an approved SE bacterin
     - treatment with antibiotics in rotation with a probiotic

4. In addition, clean and disinfect the pullet house before introducing the next flock. (See Clean and Disinfect Between Flocks: #1 CCP.)

5. Pullet organ cultures and further environmental cultures are necessary to substantiate the SE status of the flock after the corrective actions listed above had been completed. Designate a responsible person to monitor the pullet chick program, take corrective actions if SE is isolated, and file records of samples and actions taken. Verification that the HACCP plan is working is established only after a thorough review of the procedures and records of SE sampling.

6. Additional pullet management steps can include vaccination with an approved SE bacterin to enhance pullet resistance, periodic sanitizing of the water system, and supplying clean fresh feed from a mill practicing American Feed Industry Association (AFIA) sanitation principles and using animal proteins from Animal Protein Producers Industry (APPI) program sources.

7. Because communication is critical for a complete industry-wide SE reduction program, the pullet producer and buyer must be informed immediately if chicks or the environment test positive for SE.
Monitor the Environment

Monitoring the environment (manure) is necessary for all pullet and hen houses regardless of previous culture results following cleaning and disinfection (Figure 18). Bacterial evaluation of the environment is a check on the effectiveness of the actions taken at the three critical control point areas. The goal is to keep SE-negative houses negative. Results from manure culturing determine the need for more aggressive actions with pullet flocks or egg monitoring with hens; therefore, the sampling process is critical to the accuracy and reliability of laboratory results. Only random composite samples can reflect the actual bacteriologic status of the environment throughout the house.

- **Pullets**
  Monitor the pullets’ environment as a source of SE by taking the following steps:
  1. Designate someone (perhaps the person who oversees pullet chick box paper sampling) to oversee the proper sampling of the house, submit samples to the laboratory (Figure 19), and keep records of the samples and submissions.
  2. Collect manure samples (two per cage row) when the pullets are 10 to 15 weeks old and culture the samples for SE (Appendix H).
  3. If the culture results are positive, notify the pullet buyer and reculture the pullet house to confirm the results. Proceed with one of the corrective actions listed under #3 CCP (e.g., destroy the flock in a humane fashion, or rear pullets under a vigorous SE reduction program).

- **Hens**
  Monitor the environment in the laying house by taking the following steps:
  1. Designate a person or persons responsible for proper sampling of the house, submitting samples to the laboratory, and keeping records of the samplings and submissions.
  2. Implement the sampling program (Appendix H).
  3. If SE-positive pullets (as indicated by positive chick papers or pullet environment samples) were placed in the laying house, take environmental samples at 7 to 14 days following placement.
  4. Take environmental samples of all laying flocks at 29 to 31 weeks and again at 44 to 46 weeks of age.
  5. If a flock is force molted, take additional environmental samples at 5 to 7 weeks following the return to full feed.
  6. Record dates, times, and details of samples and submissions.
If any manure samples test positive for SE, take the following steps:
1. Review the biosecurity program and all CCPs for potential weaknesses and correct.
2. Initiate egg monitoring and discontinue environmental testing once egg testing is in progress.
3. Clean and disinfect the laying house before introducing the next flock. (See Clean and Disinfect Between Flocks: #1 CCP.)
4. Keep records on these actions.
Monitor Eggs

Egg monitoring is required for hen flocks in environments that test positive for SE. Initiation of egg testing eliminates the need for any further environmental testing. The results of egg testing determine whether eggs must be diverted for pasteurization or hard cooking rather than offered to the consumer as table eggs. Thus, egg testing is designed to reduce the risk of SE contaminated eggs reaching the table egg market. Reducing SE contamination in eggs is the goal of the quality assurance program, and bacteriologic testing of eggs for SE is a check on the effectiveness of the HACCP program. The accuracy of the laboratory results depends on the egg sampling process. Only a proper random sample of eggs reflects the actual bacteriologic status of eggs from hens throughout the house.

Monitoring eggs from the laying house involves taking the following steps:

1. Designate a person or persons to be responsible for proper collection of eggs, submission to the laboratory, and record keeping on the samples and submissions.
2. Implement the egg sampling program (Appendix I).
3. Collect and submit eggs four times at two-week intervals (Figure 20). Each egg submission consists of 510 nest run eggs (blood eggs or a combination of blood and nest run eggs is also suitable).
4. If the four initial egg submissions are negative, continue to submit 510 eggs once a month for the life of the flock.
5. Keep records on the dates, times, and details of all egg collections and submissions (Figure 21).

If any eggs test positive for SE, take the following corrective actions:

1. Immediately divert all flock eggs from the table egg market to pasteurization or hard cooking.
2. Review the “Biosecurity Risk Factors” chapter and CCPs for potential weaknesses and correct them.
3. Keep records on these actions.

To attempt to return the flock’s eggs to the table egg market, take the following additional monitoring steps:

1. Collect and submit 1,080 eggs four times at two-week intervals, or make a one time 4,320-egg submission.
2. If all test results are negative, the flock’s eggs may be returned to the table egg market; however, monthly submissions of 510 eggs are required for the remaining life of the flock.
3. If one or more test results are positive, continue diversion, and retest if desired. However, with 3 SE positive egg collection cultures over the life of the flock, no further testing is permitted and the eggs must by permanently diverted for pasteurization or hard cooking. All egg retest results must be negative in order to return to the table egg market. If retest results are negative and the flock’s eggs are returned to the table egg market, monthly submissions of 510 eggs are still required for the life of the flock.
4. Keep records on the dates, times, and details of all collections and submissions.
Appendices Statement

The following appendices are example forms and procedures utilized by the Pennsylvania Egg Quality Assurance Program (PEQAP) for the maintenance of egg quality in Pennsylvania. They are intended as examples and therefore are not official documents of the program. Egg producers in other states are welcome to adopt some or all of the PEQAP procedures. However, only Pennsylvania producers can enroll at this time. Those wishing to obtain official forms or enroll in the PEQAP may write or call the following office:

Animal Health and Diagnostic Services
Commonwealth of Pennsylvania
Department of Agriculture
2301 North Cameron Street
Harrisburg, PA 17110-9408
Phone: (717) 783-5309
Pennsylvania Egg Quality Assurance Program
Cleaning and Disinfection Evaluation Form

Identification
Flock ID ______________________   _____________________________
MONTH DAY YEAR

Procedures
1. Which of the following cleaning and disinfection procedures was used? (Pick one.)
a. Dry cleaning only d. Disinfection after wash-down
b. Wash-down without disinfectant e. Disinfection after washing/drying
c. Wash-down with disinfectant f. Unknown

2. Was the house fumigated? Yes ______ No ______ Unknown ______

Results
How much organic matter was present on the following surfaces? (Organic matter includes manure, feathers, eggs, and other items that should be removed during cleaning and disinfection.)

<table>
<thead>
<tr>
<th>Location</th>
<th>None of slight(^a)</th>
<th>Moderate(^b)</th>
<th>Excessive(^c)</th>
<th>NA(^d)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Cages</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Water cups</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Feeders</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Egg belts/elevators</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Drop boards</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Manure scrapers</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>7. Ceilings/walls</td>
<td></td>
<td></td>
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<td></td>
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<tr>
<td>8. Walkways/stairs</td>
<td></td>
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<tr>
<td>9. Fans/louvers</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10. Air inlets</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11. Pit floor</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12. Pit ledges/walls</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13. Pit support beams</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>14. Utility room</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15. Egg packing area</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

\(^a\) Matter is not present or is visible only on close inspection.
\(^b\) Matter is easily visible but is present only in isolated areas.
\(^c\) Large amount of matter is visible throughout the house.
\(^d\) Equipment is not present and does not apply.

Comments: ________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________

Verification
Evaluator: ____________________________
Swabbing Cleaned and Disinfected Houses

The object of culturing a house during cleaning or disinfection is to determine whether any Salmonella remain. This helps to determine whether the procedures involved in the cleaning and/or disinfection have eliminated the bacteria. Specific locations are sampled to assess whether the sanitation has been successful in these areas and across different materials (wood, metal, concrete). Commonly, the sampling and culturing is done at the end of all cleaning and disinfection procedures and after the house is completely dried. Swabbing areas that are wet and contain disinfectant will kill the bacteria on the swab and cause false negative results. There are times when culturing is done in between stages of the cleaning and disinfection process to determine which procedure, disinfectant, or application method is best. Hence, tests may be repeated for the same areas and early samples compared with later samples.

Surfaces must be free of organic material for any disinfectant to work. (For example, the goal on the cleaning and disinfection evaluation form is be in the none or slight category.)

Samples are taken by either a hand swab or a drag swab, using a latex-gloved hand and a sterile 4-by-4-inch, 8- or 12-ply gauze sponge which is saturated with canned skim milk.

**Hand swabbing:** Swab a minimum of 10 separate locations with each swab, rubbing vigorously. Two swabs are combined in a single Whirl-pak bag to make a sample. Change gloves between each sample.

**Drag swabbing:** Attach a sterile gauze sponge to the end of a string (4 to 6 feet) that can be pulled by hand or connected to a pole and dragged across the areas to be sampled. Drag each area for a minimum of five minutes. Two swabs are combined for a single sample.

If only a limited number of samples are taken, select areas that appear to have not been cleaned as well. Ideally, all of the areas listed below should be sampled.

<table>
<thead>
<tr>
<th>Sample area</th>
<th>Sampling method</th>
<th>Number of samples</th>
<th>Whirl-pak ID</th>
</tr>
</thead>
<tbody>
<tr>
<td>Walkways</td>
<td>Drag</td>
<td>1</td>
<td>Walk</td>
</tr>
<tr>
<td>Egg belts and de-escalators</td>
<td>Hand</td>
<td>1 per bank</td>
<td>1EG, 2EG, etc.</td>
</tr>
<tr>
<td>Cages</td>
<td>Hand</td>
<td>1</td>
<td>Cage</td>
</tr>
<tr>
<td>Upstairs walls</td>
<td>Hand</td>
<td>2</td>
<td>Wall-L Wall-R</td>
</tr>
<tr>
<td>Feed troughs</td>
<td>Hand</td>
<td>2</td>
<td>Trough-L Trough-R</td>
</tr>
<tr>
<td>Pit floor</td>
<td>Drag</td>
<td>2</td>
<td>Pit F-L Pit F-R</td>
</tr>
<tr>
<td>Pit ledge</td>
<td>Hand</td>
<td>2</td>
<td>Pit L-L Pit L-R</td>
</tr>
<tr>
<td>Pit poles</td>
<td>Hand</td>
<td>2</td>
<td>Pit P-L Pit P-R</td>
</tr>
<tr>
<td>Utility room</td>
<td>Drag</td>
<td>1</td>
<td>Utility room</td>
</tr>
<tr>
<td>Egg room</td>
<td>Drag</td>
<td>1</td>
<td>Egg room</td>
</tr>
</tbody>
</table>
Pennsylvania Egg Quality Assurance Program
Rodent Evaluation Form

Identification

<table>
<thead>
<tr>
<th>Flock ID</th>
<th>MONTH</th>
<th>DAY</th>
<th>YEAR</th>
</tr>
</thead>
</table>

Harborage
Check the following areas for evidence of rodent nesting or living areas.

<table>
<thead>
<tr>
<th>Area</th>
<th>Not applicable or not checked</th>
<th>None</th>
<th>Low (^1) (1–5)</th>
<th>Moderate (6–10)</th>
<th>High (&gt;10)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Holes in manure on cage support beams</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Holes at walkways and side walls</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Holes or gaps in wood sheeting of side walls</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Holes in front or rear walls</td>
<td></td>
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<td></td>
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<tr>
<td>Holes in fan housings</td>
<td></td>
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<td></td>
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<tr>
<td>Holes in walls at ledges in high-rise houses</td>
<td></td>
<td></td>
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<tr>
<td>Holes on ledges or floors in pit entrance</td>
<td></td>
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<tr>
<td>Holes in manure piles</td>
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<tr>
<td>Holes or gaps around or in doors</td>
<td></td>
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<tr>
<td>Holes in shallow pit floors</td>
<td></td>
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<tr>
<td>Holes within layers of plastic drop cloths</td>
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<tr>
<td>Holes and tunnels in attic insulation</td>
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<tr>
<td>Holes in egg processing room</td>
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<tr>
<td>Holes in egg cooler</td>
<td></td>
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<tr>
<td>Weeds, vegetation, or debris outside house</td>
<td></td>
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</tbody>
</table>

\(^1\) Record a number corresponding with the number of holes or living sites noted in specific areas.

Population
Rodents present on farm:

- Mice
- Rats
- Both

Estimate of current mouse (rodent) population:

- None or low
- Moderate
- High
- Unknown

Estimate of mouse (rodent) population is based on:

- Visual inspection
- Trapping
- Both

Comments:

- 
- 
- 

Verification
Evaluator: ________________________________
Rodent Indexing

Purpose
This protocol is used for establishing a Rodent Index (RI) in layer or pullet houses.

General
The monitoring design employs a two-step process. First, a visual inspection of the poultry facility is completed using a check-off form. Then 12 mouse traps are placed in the poultry house and the number of mice trapped are recorded, establishing the Rodent Index. The index is not designed to quantify the actual numbers of mice in a poultry house but is an attempt to assess the relative risk to the poultry flock.

Equipment required
• Flashlight
• Rodent Evaluation Form (Appendix C)
• Twelve multiple-catch mouse traps (available from Woodstream Co., Lititz, Pa.)

Procedures
1. Visual inspection: This is done on a walk-through of the house (floor walkways, pit, attic) using the Rodent Evaluation Form as a guide. It details the most common areas where mice reside. The inspection, which generally takes from 30 to 90 minutes, is done by walking through the poultry house during daylight hours with a flashlight.

2. Trapping: The next step in determining whether or not these areas are currently occupied by mice requires placing 12 traps in the areas most likely to catch mice. Traps are generally placed in two areas, either along the cage walk walls (sides, front, or rear) or on the pit ledges. Traps on the ledges can be supported by a nail driven into the ledge beneath the trap. Other areas where traps have been set include breeze-ways at the entrance of poultry houses, fan housing, and pit floor.
   a. Bait traps with a small handful of chicken feed (about 1 ounce).
   b. Place traps in areas suggestive of mouse activity, with a minimum of two traps in the pit.
   c. Check the traps after 2 to 5 days and remove and count the mice.
   d. Move the traps that have not caught any mice to a different location.
   e. Check the traps again 1 week after they were first placed.
   f. Record the total number of mice caught for the week on the Rodent Evaluation Form.

3. Rodent Index (RI): This is based on the number of mice caught and is used to estimate the rodent population. Use the following table to calculate the RI.

<table>
<thead>
<tr>
<th>Number of mice caught</th>
<th>Rodent Index</th>
<th>Description of Index</th>
</tr>
</thead>
<tbody>
<tr>
<td>0–10</td>
<td>1</td>
<td>Low</td>
</tr>
<tr>
<td>11–25</td>
<td>2</td>
<td>Moderate</td>
</tr>
<tr>
<td>26 or more</td>
<td>3</td>
<td>High</td>
</tr>
</tbody>
</table>

4. Estimation of the rodent population: Using the results of the RI and the Rodent Evaluation Form, estimate the current rodent population as none, low, moderate, or high. Indicate whether this estimate is based on visual inspection, trapping, or both.
## Appendix E

**Rodent Control Log**

<table>
<thead>
<tr>
<th>Date (month/day/year)</th>
<th>Initials</th>
<th>Set traps</th>
<th>Check traps</th>
<th>No. mice</th>
<th>Rodent Index*</th>
<th>Set bait</th>
<th>Brand name</th>
<th>Active ingredient</th>
<th>Lb used</th>
</tr>
</thead>
<tbody>
<tr>
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</tbody>
</table>

*Rodent Index*: low (1) = 0–10 mice; moderate (2) = 11–25 mice; high (3) = 26 or more mice.
Appendix F

Sampling Pullet Chick Box Papers

Obtaining a representative sample and culture of chick papers is a sensitive method for detecting the presence of Salmonella in chicks. Chick droppings, or meconium, give a good indication of prior bacterial contamination. Papers should be collected and/or swabbed so that no potential exists for contamination by the environment or personnel.

Swabbing procedure
1. Lay chick papers on a clean surface and separate them by source breeder flock(s).
2. With latex-gloved hands, take a sterile 4-by-4-inch, 8- or 12-ply gauze sponge saturated with canned skim milk and rub it vigorously across the surface of the chick paper, covering at least 75 percent of the area. Use enough pressure to rub any dry meconium off the papers.
3. Pouring a small amount of milk (1 to 2 tablespoons) on the paper will improve collection.
4. Swab five chick papers per sponge.
5. Place two sponges (a maximum of 10 combined swabbed papers) into an 18-ounce Whirl-pak bag, and add 1 to 2 tablespoons of skim milk.
6. Change gloves between each Whirl-pak sample (each 10 papers) and whenever a glove is torn.
7. Make sure hands are clean prior to swabbing, and do not apply disinfectant to gloves.

Handling samples
Transport samples on ice packs to a laboratory within 48 hours of collection. Samples can be frozen for longer storage; however, immediate delivery to the laboratory is ideal. Attach the following information to each sample: pullet flock identification and the designated layer flock(s), owner, collection date, name of person taking the sample, source breeder flock(s), hatchery, and strain of birds. An example form is provided in Appendix G.

Alternative procedure
An alternative to swabbing chick papers yourself is to send the chick papers directly to a laboratory. Select every tenth chick box paper for culture. Separate chick papers by source breeder flock(s). Place chick papers immediately into large plastic bags and close bags. Place bags in clean boxes and transport them in a timely manner to a laboratory that has agreed to test such samples. The papers do not need refrigeration.
Appendix G

Sample Submission Form

Flock ID

Date collected

Type of Sample  Check (✓) appropriate box

- Chick paper swabs
  - Breeder flock ID
  - Whirl-Pak numbers

- Pullet manure drag swabs
  - Number of samples __________

- Layer manure drag swabs
  - Number of samples __________

- Eggs in shell
  - Number of eggs __________

- Eggs, pooled
  - Number of samples __________

- Quality control samples (specify)
  - Number of samples __________

- Other (explain)

Number of samples __________

Name of submitter and company __________

Phone __________
Pennsylvania Egg Quality Assurance Program
Swabbing Pullet and Layer House Environments

Purpose
This protocol is used for collecting representative manure samples in pullet and layer houses to establish if there is environmental contamination with *Salmonella enteritidis*.

General
Two manure samples per bank of cages are required for the program. These samples must be representative of all the birds in the house. Accordingly, swabs must be dragged along each row of manure for the entire length of the house. To help ensure valid results, maintain as much consistency as possible when collecting samples.

Equipment required
1. standard biosecurity equipment
2. small cooler with three frozen ice packs
3. small garbage bag (presently provided by the Pennsylvania Egg Quality Assurance Program) containing the following:
   a. 2 Whirl-Paks per bank (Prenumber these with the house collection number; number the banks of the house from left to right as you face the banks.)
   b. pair of laboratory gloves per bank
   c. large garbage bag to serve as a tablecloth
   d. 2 sterile 4-by-4-inch, 12-ply gauze sponges per bank, pre-prepared as drag swabs (They should be pre-prepared in autoclave packs with the required number of sponges plus two extra sponges.)
   e. can of evaporated skim milk and an alcohol swab (to disinfect can before opening)
4. scissors
5. can opener
6. felt-tipped marker
7. 1-gallon plastic bag
8. set of manure drag poles (These can be constructed from a ¾-by-42-inch solid aluminum rod with a ¼-inch hole drilled ½ inch from one end, or from a ½-by-36-inch conduit with a ¼-inch hole drilled ½ inch from one end. The solid aluminum rods are easier to clean and disinfect.)

Procedures
1. Suit up and disinfect before entering the house in accordance with standard biosecurity practices.
2. Bring all materials to the bottom floor of the house. Use the bottom utility area if the house has one. Bring a bucket filled with a disinfecting solution, such as Environ 1 Stroke, and a brush for disinfecting equipment. Spread out the large garbage bag and arrange the material on it. Number the Whirl-Pak bags with the bank numbers if they have not been prenumbered.
3. Open the alcohol swab and wipe the top of the can of evaporated skim milk.
4. Disinfect the can opener and scissors with the sanitizing solution in your disinfection bucket. Use the can opener to open the can. Use the scissors to cut open the autoclave pack of swabs near the top of the pack.
5. Moisten the swabs in the pack by pouring some milk into the pack and massaging the outside of the pack. Lay the pack on the garbage bag.
6. Tear off the top of the two Whirl-Paks for bank 1.
7. Put on a pair of laboratory gloves.
8. Sample the banks from left to right. The bank on the far left will be bank 1.
9. Tie the swabs to the pole. Tie one swab slightly ahead of the other to give maximum surface area.
10. Walk the length of the house dragging the swabs along one side of the top ridge of manure. Sample one or two banks at a time. Drag the other side of the ridge on the way back.
11. Place the two swabs in a Whirl-Pak without touching the swabs. Cut attaching strings. Add approximately 5 ml of milk, close the Whirl-Pak, and place it in the 1-gallon plastic bag.
12. Use the bucket and brush to disinfect poles and scissors.
13. Remove gloves, tear off the top of the next Whirl-Pak, put on a clean pair of gloves, and remove two additional swabs from the autoclave pack.
14. Drag the remaining banks as noted above.
15. Seal the plastic bag and place it in the cooler.
16. Put all discarded material in the garbage bag.
17. Place the coolers outside the house; clean and disinfect them; then load them into your vehicle.
18. Follow standard biosecurity procedures when leaving.
19. Transport samples to a processing facility within 24 hours.

Collection adaptations
Variations in poultry house design and/or unsuitable manure pit conditions will require appropriate adaptations for collecting representative manure environmental samples. Unsuitable manure pit conditions could include situations where manure is piled very high, or is liquid or semiliquid.

1. Shallow pit: Attach two drag swabs onto the manure scraper assembly and run the scraper to the opposite end of house. Remove the swabs and place them in appropriate Whirl-Paks.

Shallow pit operations all have some type of manure scraper. Some have scrapers under each tier; some have a floor scraper only; and some have a combination of both. Each scraper blade must be swabbed. Sample only solid manure on the scrapers. The ammonia in the pit liquid may inhibit Salmonella growth. Two sponges are used to hand swab the solid manure on all scraper blades on each bank and are placed in two separate Whirl-Paks.
2. **Full width manure belt system:** Attach two drag swabs to cross conveyor equipment so as to get manure exposure on swabs from only one bank at a time. Run manure belts the full length; then remove swabs and place them in appropriate Whirl-Paks. Proceed with each bank until the entire house is sampled. Should equipment design make this procedure unworkable, an acceptable alternative would be to hand swab (using two swabs per bank) all the manure scraper blades at the end of each bank. Put one swab in each of two Whirl-Pak bags for each bank.

3. **Manure pits unsuitable for dragging:** Hand swab egg belts (approximately 10 to 12 feet on each cage level) and the de-escalators on each bank of cages. Sampling time should be from three and one-half to five minutes for each bank of cages. One swab on each side of the bank will make a sample with two swabs in one Whirl-Pak for each bank in the house. Place two drag swabs on one drag pole and drag walkways. One set of swabs for each two walkways comprises a Whirl-Pak sample.
Pennsylvania Egg Quality Assurance Program
Nest Run Egg Sample Collection

Purpose
This protocol is used for collecting representative samples of nest run eggs from layer houses. It is designed to make collection as easy as possible while providing a valid sampling technique. This protocol explains the following methods of collecting eggs:
• house collection
• nest run packing collection
• dozen carton processing collection

General
1. The Pennsylvania Egg Quality Assurance Program (PEQAP) calls for a sample size of 480 eggs in environmentally positive houses. (To allow for breakage and discarding of excessively dirty eggs, 510 eggs, or 17 flats, are actually collected.) A sample size of 1,000 eggs is called for in those houses that have had positive eggs and wish to resume table egg production. (The amount actually collected is 1,080 eggs, or 36 flats.)
2. Regardless of how many eggs are collected, it is important to get a representative sample by collecting eggs from all areas of the house.
3. You may obtain a representative sample by walking through the house and collecting eggs or by systematically collecting eggs during packing or processing.
4. Cases of eggs that have already been packed are not a representative sample because all of the eggs are more likely to come from the same area of a house.

Equipment required
1. For the 1,080 egg sample, you will need:
   a. 3 new egg cases with short dividers
   b. 42 new egg flats (36 for the eggs and 6 to cover the top layer of eggs in the cases)
2. For the 510 egg sample, you will need:
   a. 2 new egg cases with short dividers or three 15-dozen cases
   b. 20 new egg flats (17 for the eggs and 3 to cover the top layer of eggs in the cases)

Procedures
Choose one of the following methods to collect eggs.
1. House collection
   a. Plan to collect eggs when the belts are not moving.
   b. Figure out the number of eggs required per section of the house.
      Example 1. You need 510 eggs for a 6-bank house with 62 sections.
      510 eggs/6 banks is about 90 eggs per bank
      90 eggs/2 sides = 45 eggs per side
      45 eggs/62 sections = 0.73 eggs per section, or about 3 eggs for every 4 sections
Example 2. You need 1,080 eggs for a 5-bank house with 51 sections.

1,080 eggs / 5 banks = 216 eggs per bank
216 eggs / 2 sides = 108 eggs per side
108 eggs / 51 sections = 2.11 eggs per section
c. Collect the first egg from the first tier, the second egg from the second tier, and so on to the bottom tier.
d. When you come to the last section of the last row, you should just be filling your last case. If you are more than 12 eggs short, go back to the first bank and collect enough eggs from each bank to make up the difference. Note on your collection sheet how many eggs you were short initially.
e. Collect all eggs before reaching the last 6 sections of the last bank. Note on your collection sheet how many sections you skipped at the end.

2. Collection during nest run packing
a. Ensure that only one house is included in a run. Collection during nest run packing is not appropriate if eggs are being blended from more than one house.
b. Calculate the number of flats needed per pallet or rack.

Example 1. Yesterday’s production was five 30-case pallets. Each pallet had 5 layers, or a total of 25 layers.
You need 510 eggs, or 17 flats.
17 flats / 25 layers = 0.68 flats per layer
This is less than one flat per layer but more than one flat per every two layers. Remove 1 flat per pallet layer until you have 17 flats.

Example 2. Yesterday’s production was four 30-case pallets. Each pallet had 5 layers for a total of 20 layers.
You need 1,080 eggs, or 36 flats.
36 flats / 20 layers = 1.8 flats per layer
This is between one and two flats per layer. Remove 2 flats per pallet layer until you have 36 flats.

Example 3. Yesterday’s production was eight 12-case racks. Each rack had 5 layers for a total of 40 layers.
You need 510 eggs, or 17 flats.
17 flats / 40 layers = 0.425 flats per layer
This is less than one flat per every two layers. Remove 1 flat per every two layers until you have 17 flats.

3. Collection during dozen carton processing
a. Ensure that only one house is included in a run. Collection during processing is not appropriate if eggs are being blended from more than one house.
b. Calculate how many dozens are needed per pallet.

Example 1. Yesterday’s production was five 30-case pallets. Each pallet had 5 layers for a total of 25 layers.
You need 510 eggs, or 42.5 dozen.
42.5 dozen / 25 layers = 1.7 dozen per layer
Remove 2 dozen per pallet layer until you have 42.5 dozen.
Example 2. Yesterday’s production was four 30-case pallets. Each pallet had 5 layers for a total of 20 layers. You need 1,080 eggs, or 90 dozen.

90 dozen/20 layers = 4.5 dozens per layer.

This is between 4 and 5 dozen per layer. Remove 5 dozen per pallet layer until you have 90 dozen.

Alternative procedures
Producers may develop their own protocol for collecting representative samples of eggs from their houses. These protocols shall be submitted to the Pennsylvania Department of Agriculture, Animal Health and Diagnostic Services for approval. Approved protocols will be kept on file.