MANAGEMENT GUIDELINES

Raising Commercial Turkeys Without the Use of Antibiotics



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Aviagen® Turkeys

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Introduction

Whether you call it Antibiotic Free (ABF), No Antibiotics Used (NAU), No Antibiotics Ever (NAE) or Raised Without Antibiotics (RWA) there is a growing trend to produce turkeys without the use of antibiotics.

While the basics of raising turkeys remain the same, keeping the birds healthy and minimizing stress are key to having a successful ABF program. These guidelines are a framework that can be used by any operation producing turkeys without using antibiotics.

In order to achieve the genetic potential of Nicholas turkeys in an ABF environment, special attention must be given to the following items:

- Prior to placing the birds, have an agreement with the customer regarding:
  - Type of coccidiostats - some programs will only allow vaccination no chemicals
  - Whether diets are to be conventional or vegetarian
  - If Dried Distillers Grains (DDGs) can be used in the diets
- Implement a strong biosecurity program and ensure it is followed by all personnel.
- Implement and follow a strong vector control program.
- Allow adequate downtime (no birds on the farm) to keep diseases from cycling through the operation. Multi-age facilities may find it more difficult to deliver consistent and long-term success. It is highly recommended to operate ABF facilities as single age operations.
- Reduce the stocking density. Most operations will find a reduction of 10-15% a good starting point for ABF placements.
- Run a continuous water sanitation program from day one. This is a critical component of a successful ABF program and daily monitoring will assure the system is functioning properly and giving the desired results.
- Maintain precise control of temperatures and air quality with proper housing and ventilation systems. This includes having supplemental heat in the finisher barn during the cooler months of the year and enough fan power to adequately cool birds during warmer months. Bird comfort is important for proper feed consumption and gut health.
- Implement a good litter management program. This is essential for foot and leg health as well as keeping birds comfortable.
- A routine blood screening program is needed to monitor for disease challenges.

A successful ABF production program is directly proportional to the level of management and attention to details. The bottom line for success is consistent attention to detail.

These guidelines combine the collective data derived from research trials, published scientific knowledge, and the expertise, practical skills and experience of many turkey producers from across the industry.

While every attempt has been made to ensure the accuracy of the information presented, Aviagen Turkeys accepts no liability for the consequences of using this turkey management information.

For further information on raising Nicholas turkeys, contact your local technical service representative or an Aviagen Turkeys sales office.

Animal Welfare

Aviagen Turkeys is committed to the proper care of our animals. We developed these guidelines to encourage and assist the industry as they develop their own ABF management programs. Responsible management and good stockmanship are essential to good animal welfare practices.

Each growout operation should have a written Animal Welfare program developed in conjunction with its customer(s). At the heart of the policy there should be core values that address specific areas of welfare within the operation.

The environment in which turkeys are grown must take into account their needs and protect them from physical and thermal discomfort, fear and distress. Continuing education of personnel who have daily contact with turkeys is one of the most important ways to ensure proper behaviors that support and promote good animal welfare practices.

Good management practices that avoid destructive behavior, prevent disease, and promote good health and production as set forth in these guidelines, are consistent with the generally accepted practices of animal welfare. At its basis are the five freedoms of animal welfare:

- Freedom from thirst and hunger
- Freedom from discomfort
- Freedom from pain, injury and disease
- Freedom to express normal behavior
- Freedom from fear and distress

Biosecurity

Strict biosecurity procedures are essential for successful ABF production. This will reduce the exposure to infectious diseases and safeguard the health of the turkeys and consumers.

An effective biosecurity program requires the identification of the most likely sources of disease, and the establishment of practices designed to suppress the introduction and spread of pathogens into the flock. It is important to educate and routinely train employees and growers regarding sanitation procedures and disease risks.

NOTE: Always use disinfectants, rodenticides, insecticides, etc., in a safe manner and according to manufacturers' recommendations and regional regulations.

Employees & Visitors

Anyone who will be entering the facility should avoid contact with any type of birds, swine, cattle and other livestock. He / she should not visit live bird markets (flea markets), pet stores, zoos, livestock facilities, animal labs, processing plants, etc. or those people in contact with those areas.

Do not share staff between different species farms and preferably not even between poultry farms.

Maintain a Secure Facility

- Secure farm with a fence
- Keep gates and buildings locked at all times
- Post signs to prevent entry by unauthorized visitors
- Do not allow any visitors inside the secured area without approval from the farm owner or company. Persons coming from areas known to be a high risk disease area should not be allowed to enter the farm.
- Anyone entering the facility must adhere to all sanitation procedures.
- All visitors must sign a visitor log indicating date and place of last livestock contact. A minimum of 48-72 hours is generally accepted as a safe downtime between exposures to other poultry or livestock.

Sanitation Procedures

- Employees or growers must wear poultry house designated clean clothing and footwear.
- Visitors must wear clean coveralls, boots and hairnets.
- If a shower is provided, enter the shower room and shower (pay special attention to washing hair, hands and fingernails). Then enter clean room and put on clothing provided by the farm and re-sanitize hands.
- After entering the farm, at no time should the person return to the dirty room nor should any items such as towels, clothing or personal effects be transferred between the dirty and clean areas.
- Before entering and exiting turkey buildings, wash and disinfect boots and hands.
- Sanitize all items before entering the farm.
- Wash hands after breaks and lunch.

Vehicles & Equipment

- Limit traffic onto facilities as much as possible.
- Provide a vehicle disinfection area at the gate entering the facility.
- Thoroughly disinfect all vehicles, equipment and tools entering the farm and before use.
- Avoid using any equipment that has been used on other farms to prevent cross-contamination.
- Locate feed bins, fuel tanks, propane tanks, generators, etc., such that they can be serviced from outside the farm.

Birds, Rodents, Insects, Mammals

- Do not allow the accumulation of materials, trash or other debris in and around the farm.
- Maintain a “vegetation-free” zone at least 36 inches (1 meter) around all barns and control all grass and weed growth.
- Avoid and immediately clean-up any feed spills.
- Avoid and repair leaking plumbing or other sources of standing water.
- Eliminate holes, cracks and other openings where rodents or birds might enter houses.
- Eliminate nesting areas and destroy any nests that are found.
- Pest proof buildings as much as possible.
- Put out rodenticides and insecticides. Monitor bait stations regularly and rotate bait types quarterly or according to manufacturer’s recommendation.
- Continually be on the alert for pests and eliminate them when seen.
- Do not allow pets or other animals to enter the farm.

Cleaning and Disinfection

An essential element to keeping your farm free of disease is a thorough and detailed cleaning and disinfection of your barns between flocks. This is especially important for ABF flocks due to limited treatment options.

Diseases and other pathogens can be introduced in numerous ways. Taking the time to clean and properly disinfect can help to reduce this risk and break disease cycles.

Brooder House

For ABF production it is recommended that the brooder house be completely cleaned and disinfected between each flock.

- Bait for rats and mice. Rotate types of baits used quarterly or according to manufacturer's recommendation. .
- Empty feed pans, hoppers, and feed bins.
- If the previous flock was not ABF, flush feed storage and delivery systems to remove any antibiotic residue.
- Remove litter, dust and debris from barn.
- Scrape/sweep down to bare floor.

- Dry clean house using backpack blower or broom paying special attention to screens, fan housing, vents, and louvers.
- Wash house down with water, preferably hot, and a detergent product using a pressure washer.
- After barn is dry, disinfect using an approved broad spectrum disinfectant. Spray to the point of run-off or a foam sprayer. *Remember, cleaning, washing and disinfection are three separate steps.*
- Wash and disinfect any supplemental brooding equipment before bringing it back into the barn.
- Treat for insects, e.g. flies, darkling beetles, etc., as required. Rotate insecticide products to avoid building resistance.
- Clean and disinfect waterlines immediately after depopulation. Flush lines and drinkers (dump 2 – 3 times) with fresh sanitized water after line cleaning. (*See Water Line Cleaning, page 33*.)
- Do not enter clean building without proper biosecurity procedures.
- Keep doors closed and locked to keep unauthorized visitors and animals from entering barn.
- Clean, kiln dried soft wood shavings are recommended for ABF flocks.
- Bring shavings into the house after it is thoroughly dry. *Applying shavings to a wet floor can promote the growth of mold.*

Growout - Total Cleanout

For ABF production total litter removal is recommended after every flock.

- Bait for rats and mice. Rotate types of baits used quarterly or according to manufacturer's recommendation.
- Empty feed pans, hoppers, and feed bins.

- If the previous flock was not ABF, flush feed storage and delivery systems to remove any antibiotic residue.
- Remove all litter.

- Scrape/sweep down to bare floor.
- Dry clean house using backpack blower or broom paying special attention to screens, fan housings, vents, and louvers.
- Wash house with water, preferably hot, and detergent product using a pressure washer.

- After barn is dry, disinfect using an approved broad spectrum disinfectant. Spray to the point of run-off or a foam sprayer. *Remember, cleaning, washing and disinfection are three separate steps.*
- Treat for insects, e.g. flies, darkling beetles, etc., as required. Rotate insecticide products to avoid building resistance.
- Do not enter clean building without proper biosecurity procedures.
- Keep doors closed and locked to keep unauthorized visitors and animals from entering barn.
- Clean and disinfect waterlines immediately after depopulation. Flush lines and drinkers with fresh sanitized water after line cleaning. For bell drinkers this will require dumping 2-3 times. (*See Water Line Cleaning, page 33*.)
- Remove bell drinkers and hanging feeders from the barn to wash and sanitize them separately from the house cleaning and disinfection process.
- Consider treating dirt or clay pad with acid type of litter treatment. This type of treatment can be effective in reducing such pathogens as E.Coli, Salmonella, Pasturella and Clostridium.
- Bring all cleaned and disinfected equipment back into barn.
- Clean, kiln dried soft wood shavings are recommended for ABF flocks.
- Bring litter into the house after it is thoroughly dry. *Applying litter to a wet floor can promote the growth of mold.*

Growout – Non-Total Cleanout

While total cleanout is recommended for ABF flocks, this may not always be possible. Always totally clean farms with previous health issues.

- Bait for rats and mice. Rotate types of baits used quarterly or according to manufacturer's recommendation.
- Empty feed pans, hoppers, and feed bins.
- If the previous flock was not ABF, flush feed storage and delivery systems to remove any antibiotic residue.
- Dry clean house using backpack blower or broom paying special attention to screens, fan housings, vents, and louvers.
- Wash house with water, preferably hot, and detergent product using a pressure washer, even if litter is not being removed.

- After barn is dry, disinfect using an approved broad spectrum disinfectant. Spray to the point of run-off or a foam sprayer. *Remember, cleaning, washing and disinfection are three separate steps.*
- Treat for insects, e.g. flies, darkling beetles, etc., as required. Rotate insecticide products to avoid building resistance or according to manufacturer's recommendation.
- Keep doors closed and locked to keep unauthorized visitors and animals from entering barn.
- Clean and disinfect waterlines immediately after depopulation. Flush lines and drinkers with fresh sanitized water after line cleaning. For bell drinkers this will require dumping 2-3 times. (*See Water Line Cleaning, page 33*.)
- Remove bell drinkers and hanging feeders from the barn to wash and sanitize them separately from the house cleaning and disinfection process.
- It is recommended that litter be composted in-house for pathogen reduction. This will require extra down time which should be planned for in any ABF program. *(See In-house Composting, page 9)*
- If not composting, remove all caked and wet litter. Tractor mounted litter forks work exceptionally well to remove caked litter and leave dry loose material underneath.

- Till and treat litter with acid type of litter treatment. This type of treatment can be effective in reducing such pathogens as E.Coli, Salmonella, Pasturella and Clostridium. It will also aid in reducing ammonia.
- Level remaining litter and top-dress with new shavings.

In-house Composting

When a total clean out is not feasible, in-house composting is a cost-effective method of reducing disease risk for the next flock. When done properly it will help to ensure a healthy environment.

- A minimum of 14 day down time is needed to properly execute this procedure.
- Litter should have a minimum of 25% moisture.
- Create windrows of litter 24 to 48 inches (60 – 120 cm) high.

- Treat the windrows with insecticide for darkling beetles as soon as beetles start to appear, usually within the first few hours after creating windrows.
- Ensure internal litter temperature reaches a minimum of 130˚F for three days for maximum pathogen kill.
- In most situations, temperature will peak three to four days after pile creation.
- Piles should be turned three times to achieve optimum results and avoid excess ammonia.
- Peak temperature should be reached again within two days after turning.
- After the final heating litter can be spread and leveled.
- Till and treat litter with acid type of litter treatment. This type of treatment can be effective in reducing such pathogens as E.Coli, Salmonella, Pasturella and Clostridium. It will also aid in reducing ammonia.

Pre-placement Planning

Hatchery

In order to ensure clear communication a written request to the hatchery for an ABF poult delivery is highly reccommended. The following requirements should be specified

- No antibiotics injection should be given in ovo or to the poults
- Specify if the poults are to be given a vaccine and/or a probiotic
- Request hatchery label poult boxes ABF

Cocci Control

The type of Cocci control will be one of the most important decisions you will make in your ABF health program. There are three options available in most ABF programs.

1. Vaccine can be administered either at the hatchery or the farm. It is recommended that the poults be put on feed within 12 hours of vaccination. It is recommended that a dye be mixed with the vaccine that attracts the poults to preen the vaccine and also will allow the administrator of the vaccine to monitor the percentage of uptake of the vaccine by the poults. Quality control checks should be done and 92%-95% of the poults should have a dyed tongue within 10 to 15 minutes post vaccination.

2. Chemical coccidiostats are approved in most ABF programs but not all. In most cases this is a customer driven decision.

3. Alternatives- There are many new and emerging alternative products on the market today. The effectiveness of these products vary from operation to operation across the country. These products need to be tested and evaluated within your operation for effectiveness.

Probiotics

Probiotics are used in most ABF programs. There are many commercial products available that can benefit gut integrity and provide overall health benefits. These can be administered via drinking water or feed. These products need to be tested and evaluated within your operation for effectiveness.

Feed

Secure a verifiable ABF feed source. The feed mill must be able to prove that the feed is manufactured and delivered ABF and that it meets all the requirements of the customer. Delivery trucks must either be designated “ABF Only” or cleaned of all feed residue prior to loading ABF feed. ***See appendix for ABF feed mill audit tool.***

Determine whether an all-vegetable diet or a conventional diet including animal byproducts and some dried distillers grains (DDG’s) will be fed to the turkeys. DDG’s may only be included if no antibiotics were used in the manufacturing process.

On-farm feed bins must be labeled “ABF Feed Only” and feed delivery tickets should be clearly marked “ABF” to avoid costly mistakes.

Brooding

With ABF production a higher level of detail must be given during the brooding phase to ensure a successful flock. After hatch a poult has basic needs that must be satisfied if it is to survive and become a quality product. These basic needs are fresh air, clean water, quality ABF feed, good litter and heat. To improve their chances of survival, initially the poults should be confined to an area where feed, water and heat are readily available and meets their needs in order to get off to a good start.

This can be done by using a variety of brooder set-ups. The actual brooder setup will vary depending on house, stove type, brooding equipment, past experience, company preference and the time of year. An additional power source should be in place and tested on a regular basis to provide electricity during power outages.

Shavings

- Use a clean, dry mixture of coarse and fine softwood shavings. Avoid hardwoods and wet sawdust.
- New shavings are recommended for every flock.
- Spread evenly at 3 to 4 inches (7.5 to 10 cm) depth.
- Smooth to level within rings prior to setting up equipment.

Water

- Water lines should be cleaned prior to placement *(See Water Line Cleaning, page 33)*
- No vitamins should be added at placement. Always use clean sanitized water.
- For all drinkers follow the manufacturer recommendations.
- Level drinkers to make sure poults have good access.
- Make sure all drinkers have sufficient water for easy access.
- Adjust automatic depth to ¾ inch (20mm); hand fill to lip prior to placement. For every 100 poults one Plasson bell or mini drinker should be provided.
- If using nipple drinkers, double rings are recommended.

Feed

- Pre-starter crumble should be good and consistent in size with minimal fines.
- Provide one 48 inch (1.2m) trough-type feeder per 100 poults to equal 1 linear inch (25mm) per poult; or provide a combination of 18 inch (0.5m) red feeders and bucket type - 100 poults per one bucket and one 18inch (0.5m) red feeder.
- If using brooder rings, position feeders at least 12 inches (30 cm) from edge of stove and brooder guard.
- Fill feeders with fresh feed immediately prior to placement.
- Consider supplementing 48 inch (1.2m) trough-type feeders with 18 inch (0.5m) red feeders while poults are in rings for optimum feed consumption. Trays or egg flats may also be used.
- Feeder paper under the feedline with feed on it will help to attract poults to the automatic feeders.
- Keep feeders clean and free from shavings, debris and manure.

Conventional Jet Brooder Stoves

- Check propane level in tank.
- Confirm that each stove is operating properly.
- Houses should be pre-warmed a minimum of 24 hours prior to poult placement and 48 hours ahead during cold months of the year.
- Target a 3 – 4 foot (1.0-1.3m) "hot spot" of 100–105° F (38-40° C) in the center of the ring.
- Adjust all stoves to 24 inches (60 cm) above the litter.
- Confirm that the cycling of each stove provides a hot spot of no less than 100° F (38° C) and no more than 115° F (46° C) at any time.
- Set zone controlled systems so that the majority of stoves are within target range. Stoves that are hotter or cooler than target should be physically raised or lowered to achieve the desired temperatures. Proper stove maintenance may be required to reduce temperature variations.
- Use one brooder light per stove to prevent shadows and draw poults to heat source. Use only while poults are in rings.

Ventilation and Temperature Control

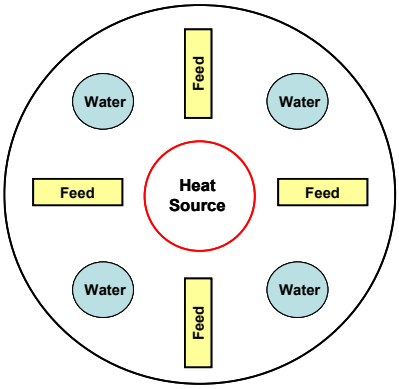
- Confirm that stoves are properly set and that all ventilation equipment is operational.
- Check all thermostats and sensors to ensure accurate readings.
- Set fan thermostats and controllers according to target temperature.
- Adjust ventilation to provide the minimum CFM's required according to the lowest anticipated outside temperatures.
- Adjust all vents to the proper opening. For wintertime ventilation a portion of vents may need to be closed off completely.
- Use mixing fans to reduce temperature stratification and improve heating efficiency. Small 18-24 inch / 45-60cm fans are recommended hanging close to ceiling at approximately 50-60 feet (15-18m) apart.
- Seal cracks and areas where air can leak in causing drafts and heat loss. Pay close attention to end doors and curtains.

Lighting

- Provide a minimum of 8 footcandles (80 lux) of light in house.
- Periods of 8-10 hours of darkness are recommended for optimum performance. Toms and light hens should have a minimum of 4 hours of continuous darkness in a 24 hour time period, as per National Turkey Federation Animal Welfare Guidelines. Other welfare guidelines may vary. Heavy hens require step down lighting. *(See Heavy Hen Lighting Program, page 16)*

Single Brooder Rings

- Check propane level in tank.
- Houses should be pre-warmed a minimum of 24 hours prior to poult placement and 48 hours ahead during cold months of the year.



- Brooder rings should be 12-15 feet (4-5 meters) in diameter
- Rings should be at least 2 feet (60 cm) away from the wall.
- Make rings with cardboard brooder guard 12-18 inches (30-45 cm) high. If the barn is drafty, use 18 inch (45 cm) brooder guard.
- Place poults per stove based on manufacturer's recommendations.

- Feeders – For every 100 poults use one 48 inch (120 cm) feeder, or one bucket feeder, or two 24 inch (60 cm) plastic feeders.
- Drinkers – For every 100 poults one Plasson bell or mini drinker should be provided. Follow manufacturer's recommendation when using nipple drinkers.
- After three days combine rings to include up to four stoves.
- After five to seven days poults can be released from rings. If using a cocci vaccine additional confinement time may be required. (See cocci vaccine considerations, page 14.)

Multi-Stove Brooder Rings

- Check propane level in tank.
- Houses should be pre-warmed a minimum of 24 hours prior to poult placement and 48 hours ahead during cold months of the year.
- Brooder rings should include no more than four brooder stoves.
- Rings should be at least 2 feet (60 cm) away from the wall.
- Make rings with cardboard brooder guard 12-18 inches (30 – 45 cm) high. If the barn is drafty use 18 inch (45 cm) brooder guard.
- If using a pancake style brooder stove a maximum of 350 tom poults or 400 hen poults per stove is recommended.
- Feeders - For every 100 poults use one 48 inch (120 cm) feeder, or one bucket feeder, or two 18-24 inch (60 cm) plastic feeders.
- Drinkers - For every 100 poults, one plasson bell or mini drinker should be provided. Follow manufacturer's recommendation when using nipple drinkers.
- After five to seven days poults can be released from rings. If using a cocci vaccine additional confinement time may be required. (See cocci vaccine considerations, page 14.)

Large Ring or Whole House Brooding

- Check propane level in tank.
- Houses should be pre-warmed a minimum of 24 hours prior to poult placement and 48 hours ahead during cold months of the year.
- One 80,000 BTU stove per 1,500 sq. ft. (460 sq. m.). This may vary based on climate and housing.
- If zone brooding it is recommended to use two electronic ignition stoves per ring, with each stove on a different circuit. It works best to have all even stoves on one circuit and all odd stoves on another circuit. A backup generator or battery is required in case of power outage.
- Stoves need to be spaced as to avoid cold spots and to be able to reach and maintain target temperatures.
- Stoves should ideally be located 7-8 feet (2.0 – 2.5m) off of the shavings, with floor temp under heater at 110-115˚F (43 - 46˚C) for day of placement; floor temperature near side walls on inside edge of cardboard should be 90˚F (32˚C).

- If piling becomes an issue, it is possible that more heat may be required. Let the flock dictate where the proper starting temperature needs to be.
- Rings should be at least 2 feet (60 cm) away from the wall.
- Make rings with cardboard brooder guard 12-18 inches (30 – 45 cm) high. If the house is drafty, use 18 inch (45 cm) brooder guard.
- All feeders and drinkers should be down and accessible to the poults.
- The use of supplemental feeders and drinker is recommended to get poults off to a good start.

Once the poults are placed in the barn, they should be allowed a minimum of one hour to acclimate themselves to their new environment. After this time, further adjustment of the ventilation, stove height, stove temperature, drinkers or feeders may be necessary. Careful observation of the poults behavior and barn conditions will determine what adjustments should be made. (*See Figure 1*)

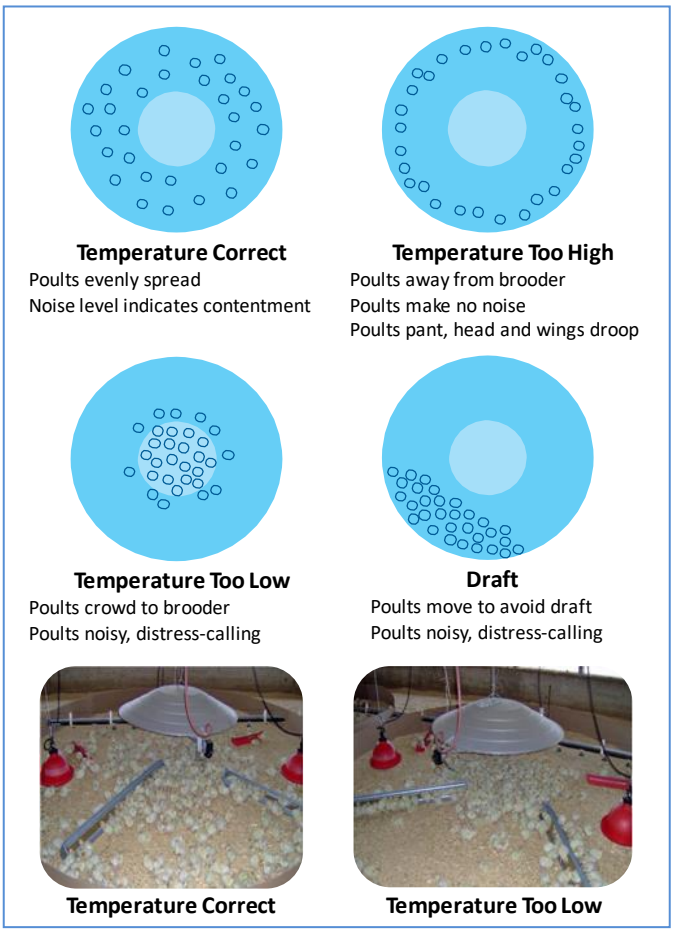
In addition to visual examination, it is very important to listen to the poults. Excessive noise may indicate wrong temperature or lack of water or feed. Avoid exposure of the poults to sudden temperature or environmental changes.

For a weekly target temperature profile *see Table 2 on page 17.*

Cocci Vaccine Considerations

If using a cocci vaccine, to improve effectiveness poults should be kept in a confined area for approximately ten days until the vaccine has had time to cycle. This can be challenging when using whole house brooding. Additionally, it is crucial to keep the poults on feed during the early brooding process. This may require keeping supplemental feeders in place longer or adding them back at the first signs of restlessness.

Figure 1. Poult Distribution Under Brooders



Growing

When growing turkeys without the use of antibiotics minimizing stress is critical. Attention must be paid to litter quality and management, and temperature - especially when transferring birds from brood to grow, ventilation should eliminate dust, control ammonia and reduce moisture. The difference between success and failure lies in proper management.

Bird Transfer

- Minimize differences between conditions in the brooding and finisher barns. In the finisher barn this may require additional heat and litter amendment if using built-up litter.
- Moving equipment should be designed for the climate conditions in your area to ensure comfort of the birds during the move.
- Avoid moving birds in inclement weather to keep birds from getting wet, chilled or overheated.
- Feed texture should be the same from the brood to finisher barn.

Litter

- Litter should be clean, dry and free from disease.
- Ensure a minimum litter depth of 4-5 inches (10-13cm).
- Tilling weekly or as needed during the flock will optimize foot pad and leg integrity.
- Consider using a litter amendment for ammonia control in extremely cold weather conditions.
- Do not compromise litter conditions for fuel savings.

Water

- Always follow manufacturer's recommendation and welfare standards for drinkers.
- For bell type drinkers:
  - Provide one drinker per 100 - 150 birds.
  - Maintain water depth at ½ to ¾ inch (12-20mm), depending on drinker style, drinking activity, ambient temperature and litter conditions.
  - Maintain lip of drinker even with height of the average birds' backs.
- Continuous water sanitation is essential for ABF production. Monitor system daily to ensure it is functioning at expected levels.
- Clean drinkers daily.
- During hot weather, flush water lines several times per day to provide fresh, cool water.

Feed

- On-farm feed bins must be labeled "ABF Feed Only" and feed delivery tickets should be clearly marked "ABF" to avoid costly mistakes.
- Ensure quality ABF feed is available when the birds are delivered.

- Provide a minimum of one (1) feed pan per 50 toms and 60 hens. Always follow manufacturer's recommendation and welfare standards.
- When birds arrive have cones adjusted to flood feed level. Feed lines should be lowered to allow easy access to feed during the transition period.
- After approximately one week when the birds have transitioned adjust and maintain the lip of feed pan even with the height of the average birds' backs. Adjust cones (feed savers) downward to avoid feed wastage.
- Check bins, augers, hoppers, etc. regularly for moldy feed and address any issues.
- In extreme heat conditions consider withdrawing feed during the hottest part of the day to lower metabolic temperature and allow birds to handle heat better.

Lighting

- Periods of 8-10 hours of darkness are recommended for optimum performance. Toms and light hens should have a minimum of 4 hours of continuous darkness in a 24 hour time period, as per National Turkey Federation Animal Welfare Guidelines. Other welfare guidelines may vary.

- For optimum performance, heavy hens require a step down lighting program during increasing day length. *(See Table 1)*
- Lighting can be increased to 24 hours during the week prior to market to prepare birds for loading.
- During periods of extreme heat, lighting should be monitored to make sure birds have adequate time to recover from the heat of the day. This may require keeping the lights on later in the day so birds have an opportunity to eat or drink during cooler hours.
- Light intensity and day length will influence activity, feed consumption, and cannibalism; adjust as needed.

Table 1. Heavy Hen Lighting Program

Fall & Winter	
Days 0-3	24 hours on
Days 4-7	4 hours darkness
Weeks 2-6	4 hours darkness
Week 7	5 hours darkness
Week 8	5.5 hours darkness
Week 9	6 hours darkness
Week 10	6.5 hours darkness
Week 11	7 hours darkness
Week 12-mkt	8 hours darkness
Spring and Summer	
Days 0-3	24 hours on
Days 4-7	4 hours darkness
Weeks 2-6	4 hours darkness
Week 7	5 hours darkness
Week 8	6 hours darkness
Week 9	7 hours darkness
Week 10	8 hours darkness
Week 11	9 hours darkness
Week 12-mkt	10 hours darkness/or as natural day length allows

Ventilation

- Confirm that all ventilation equipment is operational.
- Calibrate all thermostats to enable accurate settings.

- If power ventilating, adjust fan thermostats according to target temperature. Thermostat fans should begin to come on 2°F (1°C) above target temperature.
- Utilize heat as needed to reduce litter moisture (with increased ventilation).
- Do NOT compromise air quality for fuel savings.

Temperature

Target environmental temperatures for commercial flocks are detailed in Table 2.

Table 2. Target Environmental Temperatures

Age	Sex	Conventional Brooding °F	Conventional Brooding °C	Large Ring / Whole House Brooding °F	Large Ring / Whole House Brooding °C
Day 1	M+F	86	30	94	34
Week 1	M+F	83	28	88	31
Week 2	M+F	80	27	84	29
Week 3	M+F	77	25	82	28
Week 4	M+F	74	23	76	24
Week 5	M+F	72	22	72	22
Week 6	M+F	70	21	70	21
Week 7	M+F	68	20	68	20
Week 8	M+F	66	19	66	19
Week 9	M+F	64	18	64	18
Week 10 +	M+F	62	17	62	17

Achieving Optimum Growth

Aviagen Turkeys is the industry leader in part because of its turkeys' commercial growth rate and feed efficiency. This bird has a strong appetite and needs to achieve its early growth potential in order to develop the skeletal and cardiovascular systems necessary to support growth later in life.

Minimize Stress during Brooding

Results show that getting birds off to a good start produces the best final results. During the first six weeks of a bird's life the fundamental development of the skeleton, immune system and cardiovascular system takes place. Exposure to stress during this period compromises the development of these vital systems. Good health status, housing, bird management, feed quality and feed intake allow birds to establish the foundation required to carry them through the finishing barn.

Minimizing temperature swings, maintaining litter and air quality and a continuous water sanitation program are all key elements that will help reduce stress. An increase in square footage may be required for ABF production. This will vary depending on housing conditions, farm specific disease challenges, and overall management.

Achieve the 6 Week Target Weight

Birds that are below the weight target at the end of the brooding period tend to go through a rapid recovery phase in the finishing barn where there is typically more space and greater access to feed. Research indicates that slow early growth followed by a rapid growth period may result in a weakness in respiratory or skeletal development in a percentage of the flock. Stress later in life can then result in increased late mortality in this portion of the population. This late mortality can show up as leg weakness, cull birds and respiratory problems.

Flocks with weights close to target coming out of the brood barn do not have the same period of accelerated growth following the move and there are fewer resulting problems with late mortality. Turkeys that are closer to their genetic potential have less physiological push to alter their growth rate and consequently have a steadier growth pattern and stronger overall development.

Weigh Birds at Transfer

To achieve the best results when growing turkeys it is important to establish benchmarks to evaluate how flocks are performing. It is crucial to get accurate weights at transfer from the brooder barn. Ideally all flocks should be weighed at the same age and the sample size should be large enough to be meaningful – at least 50 birds.

Weighing all flocks allows a company to determine what birds typically weigh at transfer in its unique operation. Comparing flocks with an established benchmark is an essential tool to evaluate management, health and nutrition programs.

Identify Reasons for Under-Weight Flocks

If the target weight is not being achieved, the big challenge is to identify why and to make modifications to ensure goals are met. If an individual flock is underperforming, conditions on the farm should be reviewed. If flocks throughout the company are not meeting objectives then an evaluation of the overall management, health and nutrition programs is required.

Management practices in the brood barn can be as important as nutrition in achieving target weights. Therefore, conduct a thorough review of health, vaccination and cleaning programs, feed quality, feed texture and gut health. Additionally, environmental factors like air quality, humidity and temperature regimes should be examined. Any of these factors or a combination of several can have a severe detrimental effect on growing birds. Remember that there may be some differences in growth rates and overall flock performance between conventional and ABF flocks.

Encourage Feed Consumption

The nutritional package that is fed also has a great deal of influence on weights at the end of the brood period. However, in the first weeks of life the amount of feed birds consume is even more critical. Diets with high levels of available energy allow the bird to get off to a good start; this can be achieved by adding at least 4-5% of good quality fat. This added fat increases the energy level and improves the feed form and palatability.

A consistent crumb size with less dust will improve feed consumption. In the early stages the crumble quality needs to be small enough to encourage consumption. (*See Table 3*) Keeping birds on feed IS CRITICAL in ABF production. A disruption of feed consumption for even a few hours can result in mild enteritis that then can rapidly expand to more severe enteritis that can become unmanageable without the use of an antibiotic.

Table 3 Poult Feed Particle Size

Particle Size (mm)	%
<0.5	20
1.0 – 0.5	20
1.5-1.0	25
2.0-1.5	15
3.15-2.0	15
>3.15	5

Manage Transition to Pellet Feed

The transition from crumbled to pelleted feed must be managed to ensure that the early benefits are not lost. Birds may back off feed if pellets are too large or too long as they may not be ready for the larger size. If feed intake is reduced for 12 to 24 hours birds can lose up to a day's growth and will be more susceptible to enteric challenges.

Changing from crumbles to pellets at the same time as the move to the finisher barn can stress birds and reduce feed consumption. Therefore, it is best to wait for a few days after moving birds before changing feed texture.

Ventilation

Ventilation control is the principle means of controlling bird environment. It is essential to deliver a constant and uniform supply of good quality air at bird level. Fresh air is required at all stages of growth to allow the bird to remain in good health and achieve full potential.

Ventilation helps to maintain in-house temperatures within the birds' comfort zone. During the early part of the production period keeping birds warm is the primary concern, but as they grow keeping them cool becomes the main objective.

The housing and ventilation systems used will depend upon climate, but in all cases effective ventilation should remove excess heat and moisture and improve air quality by removing harmful gases and dust. Sensors that monitor ammonia, carbon dioxide, relative humidity and temperature are available commercially and can be used to monitor and control the ventilation system.

As turkeys grow they consume oxygen and produce carbon dioxide and water vapor. Combustion by stoves contributes additional harmful gases in the turkey house. The ventilation system must remove these harmful gases from the house and deliver good quality air.

Air Quality

The main contaminants of air within the house environment are dust, ammonia, carbon dioxide, carbon monoxide and excess water vapor. These contaminants can damage the respiratory tract, decreasing the efficiency of respiration and reducing bird performance.

Continued exposure to contaminated and moist air may trigger respiratory disease, reduce performance, contribute to poor litter quality and increase condemns.

Target levels to maximize bird performance:

Minimizing temperature swings and spikes in ammonia levels are critical in the daily management of all ABF flocks.

Carbon dioxide concentrations	below 2,500 ppm
Carbon monoxide concentrations	below 35 ppm
Relative humidity	50% - 70%
Ammonia concentrations	below 25 ppm

Housing and Ventilation Systems

There are two basic types of ventilation systems: natural and power.

Natural (Open-sided Housing), which can be:

- Non-mechanically assisted
- Mechanically assisted

Power (Controlled Environment Housing), which can be:

- Minimum
- Transitional & Tunnel
- Evaporative Pad
- Fogging/Misting

Natural Ventilation: Open-Sided Housing

Natural ventilation refers to an open-sided house with curtains. Natural ventilation involves

opening and closing the curtains to control the air flow and environment inside the house.

Curtain ventilation requires diligent management if house environment is to be satisfactorily controlled. The monitoring of conditions and adjustment of curtains is required to compensate for changes in temperature, humidity, wind velocity and wind direction.

The air exchange rate depends on outside winds, and fan assistance improves the efficacy of air circulation. On warm to hot days with little wind, fans provide a wind chill cooling effect. Foggers, misters or sprinklers should be used with circulation fans to add a second level of cooling.

In cold weather, when curtain openings are minimal, heavy outside air enters at low speed and drops immediately to the floor which can chill the birds and create wet litter. At the same time, warmer air escapes from the house which can result in large temperature swings at bird level. This can be reduced by using circulation fans helping to mix incoming cold air with warm in-house air.

Power Ventilation Systems: Controlled Environment Housing

Power or negative pressure ventilation systems are becoming more popular for controlling house environment. Better control over air exchange rates and airflow patterns provide more uniform conditions throughout the house.

Power ventilated systems use exhaust fans to draw air out of the house and create a lower pressure within the house. This creates a partial vacuum (negative static pressure) inside the house so that outside air can pass in through controlled vent openings. The speed at which air enters the house is determined by fan capacity and vent area.

Matching the vent openings to the number of exhaust fans in operation is the key to achieving correct negative (static) pressure. Mechanical controls will automatically adjust vent openings to the number of fans running. The amount of negative pressure generated can be monitored by a static pressure gauge.

Negative pressure ventilation can be operated in three different modes according to the ventilation needs of the birds:

- Minimum ventilation
- Transitional ventilation
- Tunnel ventilation

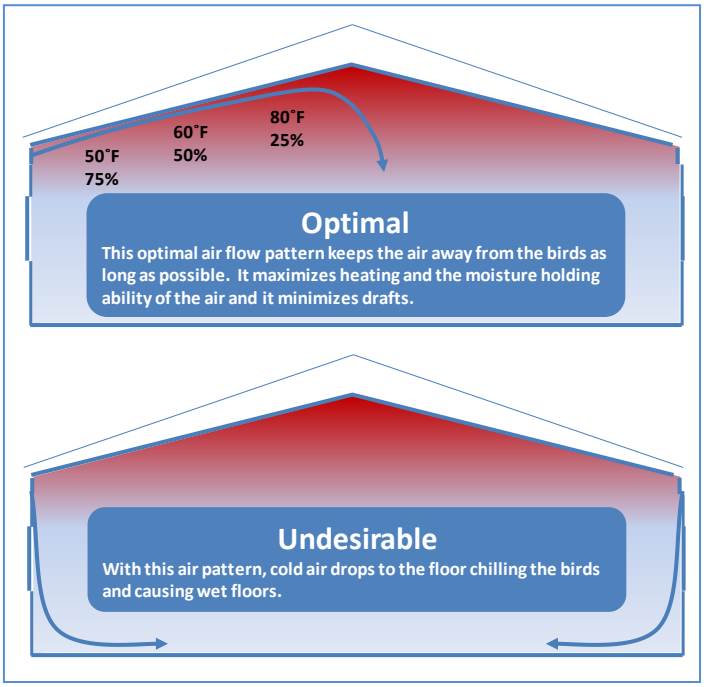
With any powered system, a standby emergency generator is required.

Minimum Ventilation Systems

Minimum ventilation is used for cooler weather and for young birds. The aim of minimum ventilation is to maintain required air temperature, bring in fresh air and remove excess moisture and harmful gases.

The key to successful minimum ventilation is creating a partial vacuum (negative pressure) so air comes through all vents and is directed across the ceiling. This will ensure that incoming air is mixed with warm in-house air above the birds rather than dropping directly onto the birds and chilling them *(see Figure 2).* This type of ventilation is preferably timer-driven.

Figure 2. Optimal Air Flow Pattern



Transitional Ventilation Systems

Transitional ventilation operates using two ventilation principles based on the outside temperature and the age of the birds. It is used where both hot and cold periods are experienced. Whereas minimum ventilation is timer-driven, transitional ventilation is temperature-driven. Transitional ventilation begins when a higher than minimum air exchange rate is required. That is, whenever temperature sensors or thermostats override the minimum ventilation timer to keep fans running.

Transitional ventilation works in the same way as minimum ventilation, but a larger fan capacity gives a larger volume of air exchange. Successful transitional ventilation requires vents linked to a static pressure controller so heat can be removed without switching to tunnel ventilation.

Tunnel Ventilation Systems

Tunnel ventilation keeps birds comfortable in warm to hot weather and where large birds are being grown by using the cooling effect of high-velocity airflow. Air movement is one of the most effective methods of cooling birds during hot weather. As air moves over a bird's hot body, heat is removed from the bird, making it feel cooler. The greater the amount of air movement, the greater the cooling effect produced. Birds will feel cooler when exposed to air movement during hot weather, and will continue to eat and grow.

Evaporative Cooling Systems

Tunnel ventilation is well-suited to the addition of an evaporative cooling system. Evaporative cooling is used to improve environmental conditions in hot weather and enhances the efficiency of tunnel ventilation. Evaporative cooling systems use the principle of water evaporation to reduce the temperature in the house.

Evaporative cooling is best implemented to maintain a required temperature in the house, rather than to reduce temperatures that have already become stressfully high.

The three factors which directly affect evaporative cooling are:

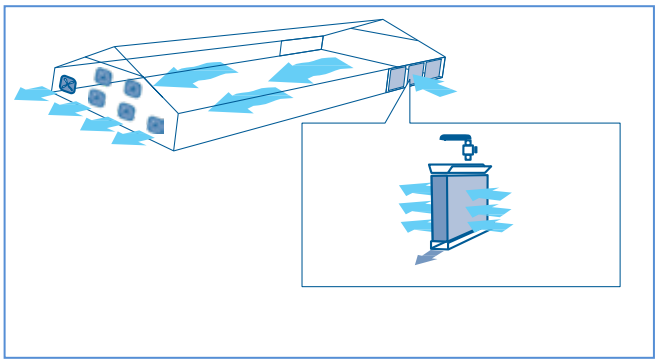
- Outside air temperature
- Relative humidity (RH) of outside air
- Evaporation efficiency

There are two primary types of evaporative cooling systems; pad cooling with tunnel ventilation and foggers, misters and sprinklers.

Pad Cooling with Tunnel Ventilation

Pad cooling systems cool air by drawing it through wetted cellulose pads (*See Figure 3*). The dual effect of pad cooling and air speed allows control of the environment when house temperatures are above 85°F (30˚C). Excessively high house humidity can be minimized by making sure that evaporative cooling pads/fogging systems do not operate at temperatures below 80°F (27˚C) in areas where the ambient humidity is high (greater than 80%).

Figure 3: Pad Cooling with Tunnel Ventilation



Fogging/Misting

Fogging systems cool incoming air by evaporation of water created by pumping water through fogger nozzles.

There are three types of fogging systems:

- Low pressure, 100–200 psi; droplet size up to 30 microns.
- High pressure, 400–600 psi; droplet size 10–15 microns.
- Ultra high pressure, 700–1,000 psi; droplet size 5 microns.

Pressure	PSI	Droplet Size
Low Pressure	100 - 200	Up to 30 Microns
High Pressure	400 - 600	10 – 15 Microns
Ultra High Pressure	700 - 1000	5 Microns

With low pressure systems, larger particle sizes can cause wet litter if house humidity is high. High pressure systems minimize residual moisture giving an extended humidity range. Fine droplet size will help avoid wet litter.

Cold Weather

During cold weather primary consideration should be given to the control of ammonia and humidity. Ventilating too little can lead to poor air and litter quality, resulting in bird health and performance issues. Ventilating too much can lead to drafty conditions, high heating costs, and high feed conversions. It is essential for ABF production during cooler temperatures that heat be available in the finisher barn in order to reduce cold stress and keep litter dry.

Following are some tips to ensure proper ventilation during cold weather.

- Maintain ammonia level below 25 ppm. If ammonia levels become too high, increase minimum ventilation level. At times it may become necessary to add heat depending on age of flock and outside temperature. The amount of ammonia produced is a function of factors such as age of litter, litter moisture, amount of caked litter and length of downtime between flocks. Adding heat helps increase the water holding capacity of the air allowing more moisture to be expelled from the house during the fan run time. The wetter the litter the more ammonia that will be produced.
- Maintain relative humidity between 50% and 70%. If the barn becomes dusty add moisture. When humidity reaches 60% begin to increase minimum ventilation rates. At times it may become necessary to add heat depending on age of flock, outside temperature and humidity.
- Ensure house tightness, there should be no air leaks. The best way to evaluate house tightness is with a static pressure test. (*See Figure 4*) Seal all cracks with caulk or foam insulation as needed. A smoke emitter will be useful to identify leaks.
- Maintain the bird's thermal comfort and avoid falling below the minimum ventilation rate regardless of the outside conditions. Without at least the minimum ventilation rate the inside air quality will deteriorate and litter moisture and ammonia problems will occur. If wet litter or

Figure 4. Procedures for Static Pressure Test

Static Pressure Test

1. Close all vents, doors, curtains, etc.
2. Turn on enough fans to equal 1 CFM per square foot (1.7 cubic meters per hour per 0.093 square meters)
3. Static pressure should be 0.2 or higher.
4. If the number is lower than 0.2, too much air is coming in through leaks and cracks. The higher the number the better the tightness.

ammonia becomes a problem, increase the minimum ventilation rate.

- Ensure that incoming air is mixed with warm in-house air above the birds rather than dropping directly onto the birds and chilling them. This requires maintaining the proper static pressure.
- Use stir fans to reduce temperature stratification. Do not direct airflow onto the birds.
- Make sure fans are well maintained and working properly. Fan belts should be tight and louvers should be clean and free of dust. Replace belts at least annually, and keep them tight between replacements.
- If the house gets too warm, check the thermostat setting not the fan timer setting.
- Maintain cables to ensure proper opening and closing of vents.
- Maintain heaters to ensure efficient operation and to reduce carbon monoxide.
- Check plumbing fixtures for leaks.
- Upgrade insulation if needed. Heavy condensation can indicate areas of poor insulation.
- During down time, empty water lines to avoid freezing and breakage.

Hot Weather Ventilation

When turkeys are exposed to excessive heat they begin to suffer from heat stress. Some signs of heat stress are decreased feed consumption, increased water consumption, gasping, open mouth panting, wing spreading, stupor, slowness and lethargy. The longer the flock is exposed to high temperatures, the greater the stress and its effects.

Following are some ventilation techniques to help control house temperature during hot weather.

- Ensure all fans are in working order, belts are tightened and fan housings are kept free of dust. Clean louvers, screens and vent openings frequently as any dust accumulation will reduce air flow.
- Set and activate alarms. This is especially critical for barns using tunnel and static pressure ventilation.
- Temperature targets will vary with flock age.
- Test alarms and other backup systems weekly.
- Properly set thermostats on both fans and curtain machines according to flock age and outside temperature considerations.
- Direct hanging fans so air flows across the birds and not up to the ceiling.
- In open sided housing sidewall screens and end door screens should be kept clean at all times to maximize air flow.
- For static pressure barns, remember the goal is to pull enough static pressure to eliminate dead air spots in the center of the barn while still increasing air volume. It is suggested to determine optimum static pressure a smoke emitter test be done. *Not all barns are the same width and will have different requirements. Check with your service technician on recommendations for your barn.*
- Set up tunnel ventilated barns in stages based on outside temperatures and bird requirements.
- For curtain sided barns, keep screens clean of dust and feathers. Keep perimeter of building clear of tall grass, equipment and any other air flow obstructions.
- Test any foggers, misters or sprinklers prior to use each summer. Nozzles can become clogged; hoses and pipes can become cracked. Dripping nozzles will reduce mist onto birds and create wet spots. Watch for drips and repair as needed.
- Do not run foggers, misters or sprinklers without also using fans.Generators, Alarms and Curtain Drops

Generators should be tested weekly, serviced and maintained as per manufacturer's recommendations. Both a service log and test log should be kept on site with equipment. Additionally, alarms and curtain drops are to be tested weekly with logs kept.

Hot Weather Management

Hot weather can have a detrimental effect on flock performance. While you cannot control outside weather conditions, you can reduce the effects of heat on your flock by following some of these tips to improve bird comfort.

Brooding

☐ Set temperatures high enough for stoves to cycle. Poults may pile if they cannot find the heat source. If stoves will not cycle due to excessive outside temperatures:

- ▶ Houses with fans - set a fan to run on thermostat
- ▶ Curtain-only houses - crack curtains enough to allow in fresh air

☐ Turn down any overhead lights to draw poults in under the heat source.

☐ Have fresh sanitized water readily available for poults.

☐ Check poults frequently soon after delivery to ensure they are settling in and not piling.

☐ As temperatures cool down at night check for drafts and ensure poults are comfortable and not piling.

Water

☐ Flush water lines during periods of excessive heat to keep water cool.

☐ Consider using electrolytes to reduce stress on birds at key times. Look for electrolyte packs with stabilized vitamin C present. Check with service technician prior to running any product on birds.

- ▶ Excessive heat (>85°F / 29°C) - run electrolytes during daylight hours and fresh water overnight.
- ▶ Moving birds to grow out - run electrolytes the day before move.
- ▶ Loading birds for processing - run electrolytes 24 hours before load.

General

☐ Lighting programs may need to be adjusted during periods of excessive heat. Birds may need more light at night so they have the opportunity to recover from the heat of the day and eat and drink while it is cooler.

☐ Ensure fly control is in place before warm weather arrives. Flies are known carriers of diseases. Do not wait until there is a problem to begin a program. *Do not assume all products are safe to use with birds present. Follow all labeled instructions.*

☐ Collect and dispose of mortality properly; failure to do so can increase the risk of spreading certain diseases. Remember that heat speeds up the decomposition process so mortality should be collected frequently.

☐ Keep grass around barns and feed tanks mowed and trimmed. Tall grass and weeds can hinder ventilation, harbor mice, rats, snakes and bees. Rodents can carry disease into your flock. Snakes and bees are a safety hazard.

☐ Keep end doors and personnel doors secured to keep animals out. These animals can carry disease into your flock.

☐ Check birds often on days of excessive heat. Ensure all fans and ventilation systems are working. Check water and ensure you have not had any system failure.

☐ Moving birds should be done early in the day before it gets too warm. Avoid pushing birds too hard or in large groups as piling may result.

Avoid tilling litter or re-bedding barns in the heat of the day. If work in the barn is required, do it first thing in the morning.

Water Vaccination

Prior to Vaccinating

- Consult your veterinarian or flock supervisor for a vaccination schedule for your flock.
- Follow the manufacturer's recommendations regarding transport, storage and disposal of vaccine and containers.
- Remove chlorine, disinfectants and other additives from the water. Presence of these materials will interfere with the vaccine. Prior to using live vaccines water sanitizers must be removed from the water, some options are:
    - Sanitizer use needs to be discontinued long enough to clear the system of any residue.
    - If water is chlorinated from the supply source use a charcoal filter to remove chlorine.
    - Test water to ensure sanitizer is removed. It may take up to two days.
- Rinse and flush water tank or ensure you have a clean medication bucket for proportioner.
- Wash drinkers the day before vaccination.
- One day prior to scheduled vaccination, run vaccine stabilizer for 12 hours to ensure sanitizers are completely inactivated.

Day of Vaccination

- Only vaccinate healthy birds.
- Restrict water intake to ensure birds are thirsty for the vaccine water.
- Two hours prior to lights coming on (or prior to normal chore activities):
    - Flush water lines with clean water
    - Raise the drinkers
    - Turn off the water
- Mix correct number of vaccine doses into enough water to last 3-4 hours.
- Add vaccine stabilizer (with blue dye).
- Flush the water lines, ensuring that all the drinkers in the house have water with blue dye. Drinkers must be emptied to get vaccine water started.
- Lower the drinkers.
- Walk through the barn every 20-30 minutes.
- Resume chlorination 4 – 6 hours after all the vaccine is consumed.

Please note vaccination alone cannot protect flocks against overwhelming disease challenges and poor management practices. Develop programs for birds in consultation with a trained poultry veterinarian. Vaccination is more effective when disease challenges are minimized; good management and biosecurity will help reduce these challenges. Base your vaccination programs on local disease challenges and remember every bird must receive the intended dose of vaccine.

Pest Management

Controlling pests requires an Integrated Pest Management (IPM) system and utilizes multiple tools to manage pests. It includes planning and implementing proper sanitation practices, mechanical devices, pest behavior and pesticides to provide a foundation to prevent pest outbreaks and predict when and what types of treatment are most economically beneficial to the grower.

The primary pests that impact poultry production are darkling beetles, rodents, flies, worms and wild birds.

Darkling Beetles

- Darkling beetles are best controlled with insecticide.
- Apply the label recommended amount of each insecticide. ***Using less than the recommended amount will lead to increased resistance to the insecticide.***
- If large populations of beetles are present, apply insecticide before placement of each flock to keep the beetle populations under control.
- If using an Organophosphate or Pyrethroid when the pH of the water is above 6, add 1 packet of Citric Acid or another acidifier to each insecticide tank mix before applying the material. These insecticides kill more beetles when the pH is lower than 6.0.
- If using a Spinosad, add 1-2 ounces of clear household ammonia per gallon of tank mix (8-16 ml/liter).
- If using a neo-nicotinoid class of insecticide, such as Imidacloprid no tank additives are necessary.
- Rotate products utilizing a minimum of four different classes of insecticide per year.
- Apply the insecticide using as little water as possible, as recommended by the manufacturer.
- Change nozzle tips to a flat fan, 04-08 nozzle tip, to get a fine mist instead of a coarse spray application.
- Do not apply insecticide to the entire house.
- Focus the insecticide applications to the areas where the beetles are living when the birds are in the house for much better control:
    - 3 foot (1 meter) wide band under the feed lines
    - 3 foot (1 meter) wide band along the walls, including the footing
    - 2 feet (60 cm) up onto the wood above the footing
- Apply the insecticide on top of fresh shavings after clean out or on top of the litter after caking out. The beetles crawl on top of the litter as they are making their way to the feed line areas after bird placement. Results are not as good if insecticide is applied on the bare floor.
- Prior to clean out apply a wall treatment such as Permethrin 10% to prevent beetles from retreating to the walls during clean out.
- After clean out or caking out, apply the insecticide currently used in rotational program to any litter stored in the litter storage shed or any piled litter. This will prevent the beetles from migrating back into the houses.
- The number of beetles killed in the first 24 hours is not the best indication of the insecticide's efficiency. Some insecticides may not work as quickly but have more long term consistent results.

- In many situations it may be necessary to use insecticide combinations in order to combat resistance issues in darkling beetles. Contact an expert for selection of the most effective combinations for your situation.
- Additionally, boric acid can be used in combination with many chemical insecticides. Boric acid can be used at every treatment as darkling beetles do not become resistant to this product.

Rodents

Control Procedures at Cleanout

- Immediately after depopulating the houses:
  - Use the most attractive baits in combination with a fast acting Bromethalin product for this process. The use of meal bait top-dressed with a small amount of Bromethalin based product has been very successful. Check with an expert to get specific instructions for this process.
  - Place shallow trays (egg flats work well) 40 feet (12 meters) apart along the walls.
  - Place one tray at each end door.
  - Put bait in each tray as recommended by the manufacturer.
  - Check and replenish the bait in the trays every day for at least 5 days.
- At any time during cleanout place bait in the attic space of the house.
- Liquid bait can be used if no water is present in the house during down time.
- Be sure to remove all bait from inside the barn prior to placing birds back. Additionally, keep doors closed to keep any non-targeted species from coming in contact with bait.
- Just prior to bird placement, pressure wash all bait stations, allow them to dry and replenish with fresh bait.

Rodent Prevention

- Do not allow the accumulation of materials, trash or other debris in and around the farm.
- Avoid and immediately clean-up any feed spills.
- Avoid and repair leaking plumbing or other sources of standing water.
- Eliminate holes, cracks and other openings where rodents might enter houses.
- Maintain a “vegetation-free” zone at least 36 inches (1 meter) around all barns and control all grass and weed growth.
- Rotate bait using different active ingredients at least three times per year to keep rodents from becoming “bait shy”.

Rodent Bait Station Placement

- For all turkey houses, place outside bait stations one every 40 - 60 feet (12-18 meters) and two on each end.

- If cool cells are being used, place 2 stations in each access area.
- Attach outside stations in an upright position to the footings or walls, ¾ inch (2 cm) above the ground. This keeps the stations in the most advantageous spots and allows them to be cleaned with a portable power washer.
- Place stations in each building / room where rodents could enter, e.g. equipment room, storage shed, entry building, break room, etc.

Rodent Bait Station Maintenance

- Treat bait stations as if they are harboring disease – they should only be handled at the end of the day and when wearing gloves.
- Keep bait stations clean and free of insects and excessive dirt.
- Keep bait fresh and dry.
- Check stations at least monthly and keep a record of rodent activity and bait consumption.
- Monthly cleaning – caution should be used during cleaning, as rodents can carry salmonella and other diseases. Contents should never be emptied where it can come in contact with birds and non-target animals.
    - Open all bait stations and remove the bait.
    - Clean the inside of the bait stations using a dry rag or a stiff bristled paintbrush.
    - Contain and carefully dispose of removed contents to avoid spreading disease.
    - Replenish with fresh bait as necessary to maintain manufacturer's recommendations.
- All bait stations should be thoroughly cleaned or pressure washed at least once per year.

Fly Control

Management Techniques

- Clean up feed and water spills.
- Properly store feed.
- Dispose of dead birds promptly.
- In compost sheds birds should be completely covered and properly managed to avoid fly infestation.
- Keep outside clear of any manure.
- Maintain a "vegetation-free" zone at least 3 feet (1 meter) around all barns and control all grass and weed growth.
- Keep perimeter vegetation short and tidy.
- Manage drinkers to minimize wet cake underneath drinkers and nipple lines.
- Maintain dry litter conditions.

Chemical Measures

- Apply an approved residual fly spray around perimeter and in the houses according to manufacturer's recommendations.
- Use bait stations or traps in areas of heavy infestation, such as corners and around doors. Ensure they are out of birds' reach.
- Apply larvacides directly to manure according to manufacturer's recommendation to control fly larva.
- A total integrated approach of multiple methods may be required if a heavy infestation exist.

Worms

Worms can have a significant detrimental effect on performance, including poor weight gain, increased feed conversion and increased mortality. Therefore worming should be done on a routine basis using a veterinary approved turkey worming program. The life cycle of a worm is 28 days, so worming should be done a minimum of every four weeks. A monitoring program may be necessary to determine if there is a problem, severity, and effectiveness of the control program.

Wild Birds

Wild birds as a disease vector can be extremely dangerous to domestic poultry. They can potentially carry a number of diseases such as Avian Influenza, MG, Exotic Newcastle as well as enteric organisms.

Control Techniques:

- Clean up feed spills promptly.
- Eliminate sources of standing water.
- Eliminate nesting and perch areas in and around barns.
- Destroy any nests that are found.
- Bird proof barns.
- Any wild birds that enter the barn need to be removed immediately.
- Keep barns closed between flocks to keep wild birds from entering.

Acknowledgement: *Aviagen Turkeys thanks Robert Rowland from MWI for his contribution to this chapter.*

Water

Water is an essential ingredient for life. Water supplied to turkeys should not contain excessive amounts of minerals and should not be contaminated with bacteria, mold or yeast. Test the water supply to check the level of calcium salts (water hardness), iron, manganese, sulfates, salinity and nitrates. After the house has been cleaned and before the birds have arrived, sample water for bacterial contamination at the source, at the storage tanks and at the last drinker. *(See Table 4)*

Table 4. Acceptable Concentrations of Minerals and Organic Matter in Water Supply

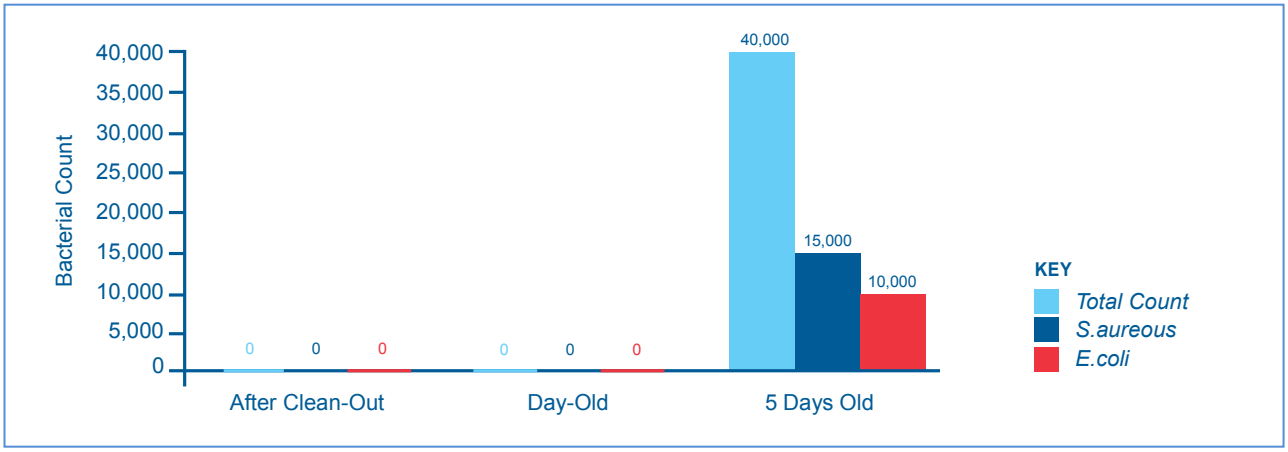
Contaminant, Mineral or Ion	Levels Considered Average	Maximum Acceptable Level	Comments
Bacteria			**Total Bacteria** is used as an indicator of system cleanliness, high numbers do not necessarily mean the bacteria present is harmful but it does mean that the system is capable of harboring pathogenic organisms. High bacteria levels can impact taste of water resulting in reduced consumption.
Total Bacteria (TPC) CFU/ml	0 CFU/ml	1000 CFU/ml	
Total Coliforms	0 CFU/ml	50 CFU/ml	**Treatment**-Shock well, then implement sanitation program such as chlorine, hydrogen peroxide or other sanitizers. Maintain a residual level of sanitizer.
Fecal Coliforms	0CFU/ml	0 CFU/ml	Presence of any **fecal coliform** means water is unfit for consumption.
pH	6.5-7.8	5-8	**pH below 5** can be harmful to drinker equipment-causing corrosion to metal components with long term exposure. **Treatment**-If pH is lower than 5 use soda ash or caustic soda injection to raise pH. **pH above 8**- impacts effectiveness of most water sanitizers. High pH associated with high alkalinity, may result in reduced water consumption due to "bitter" taste. **Treatment**- If pH is high acid injection will be required.
Total Hardness	60-180 mg/l	110 mg/l	**Total Hardness** (Calcium plus Magnesium) causes scale which reduces pipe volume and causes drinkers to be hard to trigger or leak. **Treatment**- Softeners can reduce hardness up to a practical limit of 100 gpg or 1710 ppm/mg/l. If the hardness is above 30 gpg or the sodium to hardness ratio is greater than 33% then the sodium level will be high after softening and reverse osmosis may be required.
Natural Elements			
Calcium (Ca)	60 mg/l		Birds are very tolerant of **calcium** but values above 110 mg/l may require water softener, polyphosphates or acidifier to prevent scaling. In areas of high calcium care must be taken to ensure proper calcium/phosphorus ratios for egg production.
Magnesium (Mg)	14 mg/l	125 mg/l	Higher levels of **magnesium** may cause flushing due to laxative effect particularly if high sulfate is present.

Contaminant, Mineral or Ion	Levels Considered Average	Maximum Acceptable Level	Comments
Iron (Fe)	0.2 mg/l	0.3 mg/l	Birds are tolerant of the metallic taste of **iron**. Iron can cause leaking drinkers and promote the growth of E coli and pseudomonas. Iron is linked to thick slime producing bacteria such as crenoforms. **Treatment**- Includes oxidation with chlorine, chlorine dioxide or ozone followed by filtration.
Manganese (Mn)	0.01 mg/l	0.05 mg/l	**Manganese** can result in black grainy residue on filters and in drinkers. **Treatment-** Includes oxidation with chlorine, chlorine dioxide or ozone then filtration. Green sand filtration and softeners will remove manganese. Pay close attention to pH when deciding what method to use. Farms with manganese in the water have been problematic.
Chloride (Cl)	50 mg/l	150 mg/l	**Chloride**, when combined with high sodium levels, creates salty water that can act as a laxative causing flushing. Salty water can promote the growth of *Enterococci* organisms that can lead to enteric issues. **Treatment**- Reverse Osmosis, anion exchange resin, lower dietary salt levels, blend source with non-saline water. Keep water clean and use daily sanitizers such as hydrogen peroxide or iodine to prevent microbial growth.
Sodium (Na)	50 mg/l	150 mg/l	**Sodium**, when combined with high chloride levels, creates salty water that can act as a laxative causing flushing. Salty water can promote the growth of *Enterococci* organisms that can lead to enteric issues or possibly kinky back. **Treatment**- Reverse Osmosis; lower dietary salt level; blend source with non-saline water; Keep water clean and use daily sanitizers such as hydrogen peroxide or iodine to prevent microbial growth.
Sulfates (SO_4)	15-40 mg/l	200 mg/l	**Sulfates** can cause flushing in birds. If rotten egg odor is present, then bacteria producing hydrogen sulfide (H_2S) are present. **Treatment**- System will require shock chlorination plus establishment of good daily water sanitation program, sulfates can be removed by reverse osmosis or anion resin. If H_2S is present (the rotten egg smell) then aerate water into a holding tank, treat with sanitizers then filtration.
Nitrates	1-5 mg/l	25 mg/l	High **nitrate** levels can result in poor growth and feed conversion. Presence of nitrates may also indicate fecal contamination therefore testing for bacteria is recommended. **Treatment**- Reverse Osmosis or anion exchange resin.
Lead	0 mg/1	0.014 mg/l	Long term exposure to **lead** can cause weak bones and fertility problems. **Treatment**- Reverse osmosis, softener or activated carbon will greatly reduce lead.
Copper	0.002 mg/l	0.6 mg/l	
Zinc		1.5 mg/l	

Water may have excessive nitrate levels and high bacterial counts. Where bacterial counts are high, determine the cause and correct the problem. Bacterial contamination can often reduce performance.

Water that is clean at the point of entry to the house can become contaminated by exposure to bacteria within the house environment particularly with open drinker systems, (*See Figure 5*). To maintain clean water, clean and sanitize drinkers daily and keep free chlorine levels between 3-5ppm at last drinker. The chart below demonstrates the importance of keeping the water system clean through frequent drinker cleaning and water sanitation.

Figure 5: Increase in Bacterial Count in Open Drinkers



Water Line Cleaning

Successful water sanitation begins with a thorough water line cleaning program. The variability and dynamics of water systems can create cleaning challenges, but these can be overcome with proper water analysis, a little effort and the right tools.

Choose a Cleaner

Have water analyzed for scale-causing minerals: calcium, magnesium, iron and manganese. If the water contains more than 90 ppm combined calcium and magnesium or 0.05 ppm manganese or iron, you will need to include a "descaler" or an acid in your cleaning program. These products will dissolve the mineral deposits in water lines and fittings.

Choose a cleaner that can effectively dissolve any bio-film or slime in the system. Some of the best products for this job are concentrated hydrogen peroxides.

Prior to using any strong cleaners, make sure standpipes are working properly so air pressure buildup in the lines will be released. Consult equipment suppliers before using products to prevent unnecessary damage and always follow manufacturer's recommendation.

Prepare the Cleaning Solution

For best results, use cleaning products at the strongest concentration recommended on the label. Most proportioners will only allow concentrations between 0.8 and 1.6% of the original material.

If you need to use higher concentrations it is better to mix the stock solution in a large tank and then distribute without use of a proportioner. For example, if a 3% solution is required, mix three volumes of the cleaner with 97 volumes of water for the final solution.

An excellent cleaning solution can be made up by using 35% hydrogen peroxide solution. Mix this as described for a 3% solution.

Clean the Lines

It takes 8-10 gallons (30 – 37 liters) of water to fill and clean 100 feet (30 meters) of ¾ inch (20 mm) water line. If your building is 500 feet (150 meters) long and has two water lines you should make up a minimum of 100 gallons (370 liters) of cleaning solution.

Water lines should be designed so that they can be opened to drain completely when the cleaning is complete.

Follow these steps to clean the water lines:

1) Open water lines and drain completely.
2) Begin pumping the cleaner through the water lines.
3) Watch the water as it leaves the drain line for signs of the product such as foaming or suds.
4) Once water lines are filled with the cleaner, close the tap and leave product in the lines for as long as the manufacturer recommends (over 24 hours if possible).
5) Additionally, it is recommended that all regulators be taken apart and cleaned at this point.
6) Flush cleaner from the water lines after the holding period. Water used to flush the lines should contain the level of sanitizer normally used in the drinking water.

   In the absence of a standard water sanitation program add 4 ounces of 5% bleach per gallon (32 ml / liter) of stock solution and proportion at a rate of 1 ounce per gallon of water (0.8% or 1:128). This will provide approximately 3–5 ppm of free chlorine in the final rinse water.

7) Water lines from the source to the turkey barns should also be cleaned and sanitized between flocks. Do not flush the outside water lines through the water lines inside the buildings. Connect a water hose to the medicator faucet to drain the outside lines

Remove Mineral Build-up

After lines are cleaned, use a de-scaler or acid product to remove the mineral build-up. Excellent commercial de-scaler products are now available which will effectively remove scale build-up without damaging equipment. Visit with your local animal health product supplier for options. Use product according to the manufacturer's recommendation.

Figure X. Mineral Deposits Before and After Descaling

After de-scaling, empty the water lines. Then refill the lines with clean water containing 8-12 ounces of 5% bleach per gallon (64-95 ml / liter) of stock solution proportioned at one ounce per gallon (0.8% or 1:128). Leave in the water lines for four hours. This concentration of chlorine will kill any residual bacteria, and further remove bio-film residue.

Perform a final flush of the water lines using water with a normal drinking water level of sanitizer (4 to 6 ounces of 5% bleach per gallon (32 – 48 ml / liter) of stock solution proportioned at one ounce per gallon). Continue flushing until chlorine smell is gone. Test the water in the lines to make sure it contains no more than 5 ppm of free chlorine.

Keep the System Clean

Once the system has been cleaned, it is important to keep it sanitized. Develop a good daily water sanitation program for your birds. The ideal water line sanitation program should include optimizing sanitizer residual which requires injecting an acid if chlorine is used. It is important to note that the procedure requires two injectors since acids and bleach should **never** be mixed in the same stock solution.

If only one proportioner or injector is available, then inject bleach (concentration of 5%) at a rate of 4 to 6 ounces per gallon (32 – 48 ml / liter) stock solution; proportion at 1 ounce of stock solution per gallon of drinking water.

The objective is to provide a clean source of drinking water with a continuous level of sanitizer (3-5 ppm of free chlorine) at the last drinker without over sanitizing the drinkers at the front of the barn.

Water Sanitation

Utilization of sanitizers approved for use in the drinking water of food animals provides protection from pathogens that may be naturally occurring in water sources or which get seeded into water systems by sick birds and other vectors. By maintaining residual levels appropriate for the different types of sanitizers commonly used, many operations can effectively limit disease challenges.

Chlorine is the most popular sanitizer because it is inexpensive to use and widely available. The three most commonly used forms are gas chlorine, sodium hypochlorite (liquid bleach) and calcium hypochlorite (dry or tablet form). Chlorine is most effective in the hypochlorus form which is the most prevalent when the pH is between 4 and 7. Therefore, optimal sanitation with chlorine typically requires additional injection with an acid.

Other commonly used water sanitizers are chlorine dioxide, iodine and hydrogen peroxide (*See Table 5, page 35*).

Table 5. Commonly Used Water Sanitizers

Sanitizer	Common Forms	Target Residual	Comments
Chlorine	Gas-(Cl_2) Sodium hypochlorite (NaOCl) Calcium Hypochlorite (Ca(OCl)2	3-5 ppm free chlorine	Chorine is most effective when water pH is adjusted to 5-7. Effective in oxidizing manganese, iron and sulfur. Some pathogens are resistant to chlorine. Inexpensive
Chlorine Dioxide	Generated by reacting liquid sodium chlorite with an acid	0.8-2.0 ppm Per product recommendations	Effective against chlorine resistant pathogens and effective over a wide pH range (5-9). Also effective in oxidizing iron and manganese. Expensive
Iodine	Sodium Iodate-$NaIO_3$	1-2 ppm	Not as effective as chlorine as a virucide. More effective at pH neutral to slightly basic. Expensive
Hydrogen Peroxide	H_2O_2	25-50 ppm	Not as effective in oxidizing iron and manganese. Stabilized products provide residual longer than non-stabilized forms. Expensive
Ozone	O_3		Unstable so must be generated at point of use. No residual. Very effective germicide and virucide. Must filter water post-ozonation. Expensive

Additional Considerations:

Drinker valves and pipes may become blocked if the water is hard and contains high levels of calcium salts or iron. If sediment blocks the pipes, filter the supply with a mesh of 40–50 microns.

Do not use acid as the sole method of water treatment since acids alone can cause bacterial or fungal growth in water systems.

When administering other products to your birds it is a good idea to stop the inclusion of chlorine (and other sanitizers) in the drinking water. Chlorine will inactivate vaccines, and reduce the effectiveness of some medications. Resume use of chlorine and/or other sanitizers after treatment is finished.

Aviagen Turkeys thanks Dr. Susan Watkins from the University of Arkansas for her contribution to this chapter and for her work with the turkey industry on developing water sanitation programs.

Feed Production and Loading

Producing ABF Feed

The following are operating procedures to be followed when batching and pelleting ABF feed to prevent contamination.

- Ensure all ABF batching and pelleting follow a non-medicated feed and a flush as per the established protocol.
- Verify all scales are zeroed. There should be a written SOP for this or it may be verified thru the mill's computerized batching system.
- If fat is added into the mixer, ensure there is a separate application systems for vegetable and non-vegetable fats if the requirement is for an all-vegetable diet.
- Schedule a flush consisting of 500-600 lbs. of ground corn.
- Route the flush to the empty mash bin intended for non ABF production.
- Open the pellet mills and thoroughly scrape and clean them.
- Once the flush is run into the mash bin, start up the pellet mill at 5 tph and 100 degrees F to run the corn flush through the pellet mill.
- Ensure the corn flows thru the cooler and loadout bins where ABF feeds will be stored.
- Load the corn flush and transfer it to the recycle bin.
- Once the flush is complete, the ABF feed may be batched into the now "clean" mash bin and run into one of the designated ABF finished feed bins.
- A signed documented process needs to be in place.

Loading ABF Feed

The following are operating procedures to be followed when loading finished ABF feed to prevent contamination.

- All ABF feed will be loaded into a truck previously carrying an ABF load. If a truck that previously carried a conventional load must be used, the truck must be flushed as follows:
  - Place 1000 lbs. of ABF feed in the first compartment (from the front of the trailer).
  - Run feed through belly auger, upright auger and out the boom of the trailer to clear any residual feed.
  - Flush feed can be used in the mill as "Miscellaneous "for rework into conventional feeds.
  - A Signed documented process needs to be in place.
- Clearly state on the load out form that the load is ABF with the intended farm name and houses listed.
- Gather a one pound retention sample from each formula on each load. The sample should state the date manufactured batch number, feed type, load out bin number, name of person taking the sample.
- Of the retention samples taken, send 25% daily to the lab for antibiotic contamination testing and animal by-product testing if it must be an all-vegetable diet. Daily testing and early detection of contamination may allow feed to be reclaimed prior to birds consuming it and losing their certification. Should a sample fail this test, take the following steps:
  - Lab should notify the Mill Manager and Growout Manager of a possible problem.

- The lab should have a positive and negative control testing procedure in place to validate the accuracy of each lot of test kits.
- After the test kit lot is validated as accurate, the lab should run multiple tests on the positive samples to validate the preliminary test results.
- If the preliminary sample tests are confirmed positive then all other ABF Samples produced from that shift should be tested.
- As soon as the preliminary sample is confirmed positive the lab will notify the Mill Manager and Growout Manager.
- The Growout Manager will investigate and confirm if the flock (on a house by house basis) has been compromised. Any and all feed that has not been consumed by a compromised house will need to be isolated and picked up immediately to prevent the possibility of becoming compromised.
- The Growout Manager will communicate to the processing plant the compromised house numbers.

Post Mortem Examination

The objective of post mortem examination in the field (field necropsy) is to provide information that can be combined with flock history and field observations to help to determine the causes of performance problems, clinical signs and mortality.

Field necropsy should be backed up with laboratory diagnostic investigations on tissue samples, serology and live/dead mortality specimens, especially if the field problem persists. The technique of turkey necropsy in the field can vary, but the following can serve as a general guideline.

Case History of the Flock

A key to identifying health problems is understanding the flock history. Accurate records are important and should include the following information:

- Age
- Flock size
- Morbidity (sick birds and mortality numbers)
- Principal clinical signs noted and duration of clinical signs
- Previous flock/farm history
- Management factors:
  - Feeding & water systems
  - Housing
  - Ventilation
  - Litter conditions
  - Vaccination/medication program
- Unusual management changes
- Last handling of birds
- Performance records (egg production and weight gains)
- Breeder flock source
- Feeding regime

Observe Clinical Signs of Disease

Monitor the flock and note any abnormal behavior such as:

Respiratory: Gasping, nasal discharge, snicking, swollen sinuses, mouth breathing, coughing, blood in mouth.

Digestive signs: Diarrhea, soiled vent, excessive chirping.

Nervous signs: Head and neck held in an abnormal manner, tremors, spasms, paralysis, circling motion.

Locomotive signs: Unable to stand or walk, limping, poor gait, inability to use one or both legs, lying on side, swollen foot pads and swollen joints.

Observe the Bird in Question

Examine the exterior surface of the bird and note the following:

General condition: Thin, good flesh, trauma, dehydrated.

Examine the head: Eyes, sinus, eye lids, and oral cavity.

Examine the legs, hocks and note mobility: Palpate legs, joints and feet.

Examine the skin for external parasites, particularly beneath the vent: Lice and mites.

Necropsy Equipment to Have on Hand

- Sharp knife
- Scissors (blunt point)
- Bone shears
- Forceps
- Disposable or rubber gloves
- Vacutainers or plastic tubes for blood collection
- Whirl packs for tissue samples
- 10% buffered formalin solution in a wide-mouth plastic container
- Sterile swabs for bacterial culture
- Disinfectant to clean and disinfect equipment

Post Mortem Examination

There are a number of procedures used. What is important is to make sure that one proceeds with the necropsy in an orderly fashion. This will reduce the chance of overlooking something.

1. Euthanize the bird according to your company's approved welfare standards.

2. Place bird on its back. Incise the loose skin on the inside of each thigh. Grab the leg in one hand and holding the body with the other hand, pull the leg down and outward from the body until the hip joint is disarticulated.

3. Cut the skin across the lower abdomen. Pull the skin over the breast, sternum and crop. Examine the breast muscle and subcutaneous tissue for any abnormal appearances such as blisters, hemorrhage, dehydration (darkening of the muscle), etc.

Poults, 1-7 days of age:

1. Fold both wings over the breast muscle and hold both with one hand. With the other hand, hold the neck and work the thumb down between the crop and breast muscle to the thoracic inlet.
2. Pull the wings and breast muscle back towards the tail with one hand while the other hand holds the neck with the thumb pushing down against the thoracic inlet and cervical vertebrae, separating the breast muscle and wings away from the back bone.
3. Poults can also be opened by cutting the clavicular and coracoid bones (the thoracic inlet, wish bone area) and then through the rib cage and abdominal wall.

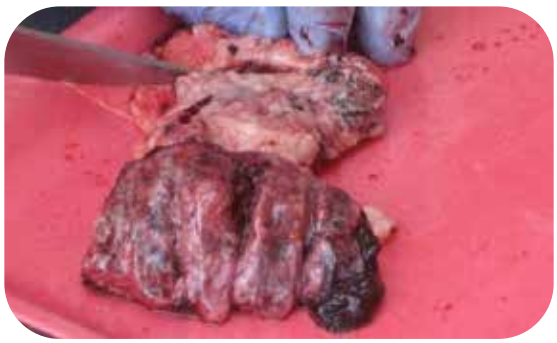
4. For fresh dead, break down the adhesions between the heart and breast bone prior to lifting up on the keel bone.

5. Using bone shears, cut through the ribs and under the clavicle and coracoid bones (on older birds, two cuts can be made above the shoulder area down through the breast muscle to the shoulder joint). This will assist you when reflecting the keel.

6. Pull the keel forward to allow access to the internal organs. Examine liver, heart, gizzard, intestines and air sacs without touching them.

7. Take bacterial cultures (liver, pericardial sac) or tissue samples and the whole bird for virus isolation and additional investigations.

8. Hold the gizzard and pull, along with the intestines, to the bird's right side.
9. Examine the spleen and air sacs. Take bacterial cultures from spleen and/or air sacs, if necessary.
10. Remove the lungs and examine. Note the consistency and color. Make several transecting cuts over the lung and examine lung tissue.



11. Hold proventriculus, cut esophagus near proventriculus junction and then pull out the entire digestive system including liver, spleen and small intestines and lay small intestines out.
12. Examine liver, kidneys, pancreas, surface of the intestines and gonads.
13. Examine the stifle, hock joints and tendons.
14. Examine leg bones (tibiotarsus) for rigidity by bending and breaking the bone to check for nutritional deficiencies in young poults (rickets). A healthy bone should make a snap when it breaks.
15. Examine the tibia (growing birds) by cutting longitudinally on the medial inside surface through the epiphysis to examine for abnormalities (TD, osteomyelitis and others).

16. Examine costochondral junctions (ribs) for enlargements (beading).
17. Cut through the left side of the mouth (use heavy scissors) and continue the incision through the skin and esophagus to the thoracic inlet and pull the skin laterally.

18. Examine oral cavity and organs of the neck region (thymus, thyroids and parathyroid).
19. Make a longitudinal cut through the larynx and trachea. Examine for blood, congestion, etc.
20. Examine esophagus and crop. Note any abnormalities in esophagus and crop such as crop mycosis (candidiasis), trichomoniasis or capillary worms.
21. Make a lateral incision through the wall of the infraorbital sinus and examine for exudates, etc.
22. To examine the brain, remove the skin on the skull. Then remove the skull bone by cutting the bone all the way around the periphery of the cranial cavity with heavy scissors or heavy bone shears. Lift the loosened portion of the bony skull with forceps or scissors.
23. Examine the digestive system by making a longitudinal cut through the proventriculus, gizzards, small intestines, cecum, colon and rectum.
24. Examine the intestines by making a longitudinal cut through the wall of the intestines continuing to cut in order to inspect the bird for worms.

In order to make the best use of information derived from field post mortem examinations, field supervisors/ managers should routinely post the flock mortality to gain experience in detecting the normal from abnormal tissue/ organ conditions.

Appendix 1 – Daily Water Consumption

Daily Water Consumption based on 1,000 Turkeys

(Weight, diet & health may affect consumption)

	Gallons			Liters		
Age Weeks	Up to 75°F Up to 24°C	75 to 90°F 24 to 32°C	Over 90°F Over 32°C	Up to 75°F Up to 24°C	75 to 90° Up to 32°C	Over 90°F Over 32°C
1	11	11	11	40	42	42
2	23	28	28	87	107	107
3	35	39	44	131	147	167
4	47	57	61	179	215	231
5	58	67	86	219	254	326
6	75	89	108	282	338	409
7	90	105	124	342	397	469
8	111	137	141	421	517	533
9	139	163	182	525	616	688
10	149	173	207	564	656	783
11	166	205	234	628	775	886
12	191	219	263	723	831	994
13	196	254	278	743	962	1053
14	205	261	295	775	990	1117
15	207	265	299	783	1002	1133
16	209	267	300	791	1010	1137
17	210	269	302	795	1018	1145
18	213	272	307	807	1029	1161
19	215	275	310	815	1041	1173
20	217	277	313	823	1049	1184
21	221	280	316	835	1061	1196

Appendix 2 – Water / Sanitizer Check Sheet

Daily Water Consumption / Sanitizer Level

Farm _____ Hatchery _____ Flock _____

Barn _____ Number Started _____ Placement Date _____

Week	Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Water Additives
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								
11								
12								
13								
14								
15								
16								
17								
18								
19								
20								
21								
22								

Appendix 3 – Mortality Check Sheet

Mortality / Euthanized

Farm _____ Hatchery _____ Flock _____

Barn _____ Number Started _____ Placement Date _____

Week	Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Total	Cum.
1									
2									
3									
4									
5									
6									
7									
8									
9									
10									
11									
12									
13									
14									
15									
16									
17									
18									
19									
20									
21									
22									

Appendix 4 – FLAW Check Sheet

Feed, Litter, Air and Water Checklist

Farm _____ Hatchery _____ Flock _____

Barn _____ Number Started _____ Placement Date _____

Week	Sunday		Monday		Tuesday		Wednesday		Thursday		Friday		Saturday	
1	Feed	Litter	Feed	Litter	Feed	Litter	Feed	Litter	Feed	Litter	Feed	Litter	Feed	Litter
	Air	Water	Air	Water	Air	Water	Air	Water	Air	Water	Air	Water	Air	Water
2	Feed	Litter	Feed	Litter	Feed	Litter	Feed	Litter	Feed	Litter	Feed	Litter	Feed	Litter
	Air	Water	Air	Water	Air	Water	Air	Water	Air	Water	Air	Water	Air	Water
3	Feed	Litter	Feed	Litter	Feed	Litter	Feed	Litter	Feed	Litter	Feed	Litter	Feed	Litter
	Air	Water	Air	Water	Air	Water	Air	Water	Air	Water	Air	Water	Air	Water
4	Feed	Litter	Feed	Litter	Feed	Litter	Feed	Litter	Feed	Litter	Feed	Litter	Feed	Litter
	Air	Water	Air	Water	Air	Water	Air	Water	Air	Water	Air	Water	Air	Water
5	Feed	Litter	Feed	Litter	Feed	Litter	Feed	Litter	Feed	Litter	Feed	Litter	Feed	Litter
	Air	Water	Air	Water	Air	Water	Air	Water	Air	Water	Air	Water	Air	Water
6	Feed	Litter	Feed	Litter	Feed	Litter	Feed	Litter	Feed	Litter	Feed	Litter	Feed	Litter
	Air	Water	Air	Water	Air	Water	Air	Water	Air	Water	Air	Water	Air	Water
7	Feed	Litter	Feed	Litter	Feed	Litter	Feed	Litter	Feed	Litter	Feed	Litter	Feed	Litter
	Air	Water	Air	Water	Air	Water	Air	Water	Air	Water	Air	Water	Air	Water
8	Feed	Litter	Feed	Litter	Feed	Litter	Feed	Litter	Feed	Litter	Feed	Litter	Feed	Litter
	Air	Water	Air	Water	Air	Water	Air	Water	Air	Water	Air	Water	Air	Water
9	Feed	Litter	Feed	Litter	Feed	Litter	Feed	Litter	Feed	Litter	Feed	Litter	Feed	Litter
	Air	Water	Air	Water	Air	Water	Air	Water	Air	Water	Air	Water	Air	Water
10	Feed	Litter	Feed	Litter	Feed	Litter	Feed	Litter	Feed	Litter	Feed	Litter	Feed	Litter
	Air	Water	Air	Water	Air	Water	Air	Water	Air	Water	Air	Water	Air	Water
11	Feed	Litter	Feed	Litter	Feed	Litter	Feed	Litter	Feed	Litter	Feed	Litter	Feed	Litter
	Air	Water	Air	Water	Air	Water	Air	Water	Air	Water	Air	Water	Air	Water
12	Feed	Litter	Feed	Litter	Feed	Litter	Feed	Litter	Feed	Litter	Feed	Litter	Feed	Litter
	Air	Water	Air	Water	Air	Water	Air	Water	Air	Water	Air	Water	Air	Water
13	Feed	Litter	Feed	Litter	Feed	Litter	Feed	Litter	Feed	Litter	Feed	Litter	Feed	Litter
	Air	Water	Air	Water	Air	Water	Air	Water	Air	Water	Air	Water	Air	Water
14	Feed	Litter	Feed	Litter	Feed	Litter	Feed	Litter	Feed	Litter	Feed	Litter	Feed	Litter
	Air	Water	Air	Water	Air	Water	Air	Water	Air	Water	Air	Water	Air	Water
15	Feed	Litter	Feed	Litter	Feed	Litter	Feed	Litter	Feed	Litter	Feed	Litter	Feed	Litter
	Air	Water	Air	Water	Air	Water	Air	Water	Air	Water	Air	Water	Air	Water
16	Feed	Litter	Feed	Litter	Feed	Litter	Feed	Litter	Feed	Litter	Feed	Litter	Feed	Litter
	Air	Water	Air	Water	Air	Water	Air	Water	Air	Water	Air	Water	Air	Water
17	Feed	Litter	Feed	Litter	Feed	Litter	Feed	Litter	Feed	Litter	Feed	Litter	Feed	Litter
	Air	Water	Air	Water	Air	Water	Air	Water	Air	Water	Air	Water	Air	Water
18	Feed	Litter	Feed	Litter	Feed	Litter	Feed	Litter	Feed	Litter	Feed	Litter	Feed	Litter
	Air	Water	Air	Water	Air	Water	Air	Water	Air	Water	Air	Water	Air	Water
19	Feed	Litter	Feed	Litter	Feed	Litter	Feed	Litter	Feed	Litter	Feed	Litter	Feed	Litter
	Air	Water	Air	Water	Air	Water	Air	Water	Air	Water	Air	Water	Air	Water
20	Feed	Litter	Feed	Litter	Feed	Litter	Feed	Litter	Feed	Litter	Feed	Litter	Feed	Litter
	Air	Water	Air	Water	Air	Water	Air	Water	Air	Water	Air	Water	Air	Water
21	Feed	Litter	Feed	Litter	Feed	Litter	Feed	Litter	Feed	Litter	Feed	Litter	Feed	Litter
	Air	Water	Air	Water	Air	Water	Air	Water	Air	Water	Air	Water	Air	Water
22	Feed	Litter	Feed	Litter	Feed	Litter	Feed	Litter	Feed	Litter	Feed	Litter	Feed	Litter
	Air	Water	Air	Water	Air	Water	Air	Water	Air	Water	Air	Water	Air	Water

Appendix 5 – Conversion Data

WEIGHT

1 ounce	=	28.35 grams
1 pound	=	16 ounces
1 pound	=	453.6 grams
1 pound	=	7,000 grains
1 ton (USA)	=	2,000 pounds
1 metric ton	=	2,204.62 pounds
1 long ton	=	2,240 pounds
1 kilogram	=	2.2046 pounds
1 gram	=	1,000 milligrams
1 milligram	=	1,000 micrograms
1 microgram/gram	=	1 part per million
1 bushel of wheat	=	61 pounds / 0.0272 metric tons
1 bushel of corn	=	56 pounds / 0.0254 metric tons
1 bushel of soybeans	=	60 pounds / 0.0272 metric tons

AREA

1 square foot	=	0.093 square meters		
1 square meter	=	10.764 square feet		
1 acre	=	43,560 square feet	=	0.405 hectare
1 hectare	=	10,000 square meters	=	2.471 acres
1 square mile	=	2.6 square kilometers		

LENGTH

1 centimeter	=	0.3937 inches
1 meter	=	3.2808 feet
1 foot	=	0.3048 meters
1 kilometer	=	0.6214 mile
1 mile	=	5,280 feet
1 mile	=	1.609 kilometers

TEMPERATURE

^{o}Fahrenheit	=	(^{o}Celsius X 9/5) + 32
^{o}Celsius	=	(^{o}Fahrenheit - 32) X 5/9

FLUID MEASURE

1 fluid ounce	=	30 ml
1 pint (U.S.)	=	473 ml
1 quart (U.S.)	=	946 ml
1 liter	=	1,000 ml
1 liter	=	1.057 quarts (U.S.)
1 gallon (U.S.)	=	3.785 liters
1 part per million	=	0.0001%

VOLUME

1 ml	=	0.061 cubic inches
1 cubic meter	=	35.3145 cubic feet

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