BROILER

Pocket Guide

2015

An Aviagen Brand

Introduction

This Pocket Guide was produced to complement the Ross® Broiler Management Handbook. It should be used as a quick and practical reference for broiler stock management. Each section contains cross-references to relevant sections of the Ross Broiler Management Handbook where further information, if required, can be found.

This Pocket Guide is not intended to provide definitive information on all aspects of broiler stock management, but draws attention to important management practices which, if overlooked, may reduce flock performance.

Performance

This Pocket Guide summarizes best management practice for broilers kept under good nutritional, management, and health conditions, and are considered to be the most appropriate for achieving good broiler performance (live and through processing), health, and welfare.

However, the information within this Pocket Guide cannot wholly protect against performance variations which may occur for a wide variety of reasons.

For further information on the management of Ross broiler stock, please contact your local Technical Service Manager or Technical Services Department.

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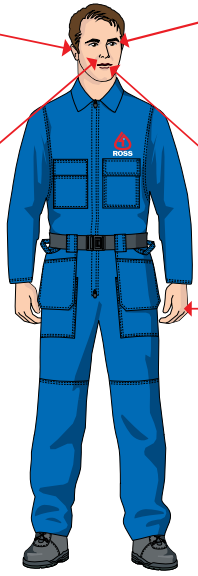
Stockmanship

Stockmanship is a continuous process that uses all of the stockman's senses to monitor the flock.



Hearing
Listen to the birds' vocalization, breathing, and respiratory sounds. Listen to the mechanical sounds of fan bearings and feed augers.

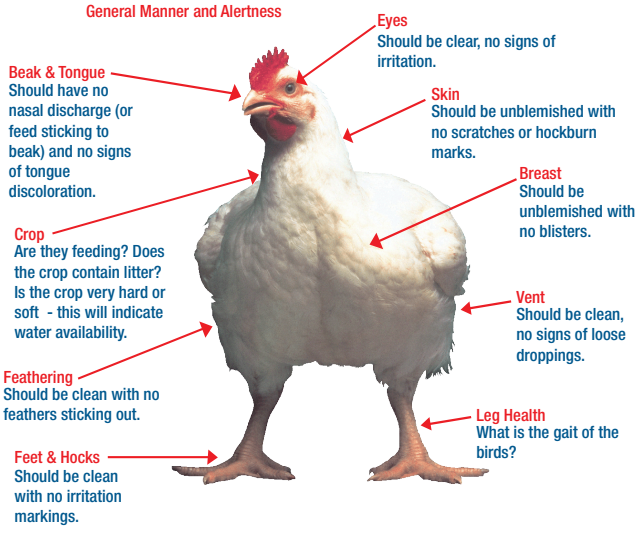
Sight
Observe behavior such as bird distribution in the house and number of birds feeding, drinking, and resting. Observe the environment such as dust in the air and litter quality. Observe bird health and demeanor such as posture, alertness, eyes, and gait.

Smell
Keep notice of smells in the environment such as ammonia levels. Is the air stale or stuffy?

Taste
Water and feed quality.

Touch
Handle the birds to assess crop fill and check the birds' general condition. Take notice of air movement across your skin. Is there a draft? What does the temperature of the house feel like?

Stop to handle and assess a number of individual birds for the following:



- Compare this 'stock sense' information with actual farm records - are the birds on target?
- Investigate any irregularities and develop an action plan to address any issues.

BIRD HANDLING

It is important that all birds are handled in a calm and correct way at all times. All people handling birds (for catching, weighing, and physical assessment) should be experienced and appropriately trained so that they can handle the birds with the care that is appropriate for the purpose and age of the bird.

Section 1

Chick Management

Objective

To promote early development of feeding and drinking behavior. This will allow the target body-weight profile to be achieved with maximum uniformity and good welfare.

Pages	Contents	*Handbook Reference Page*
08	Chick Management	*14*
12	Brooding Management	*14*

Chick Management

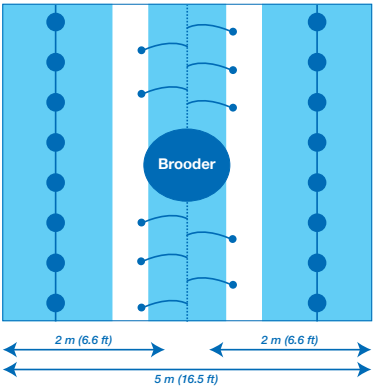
Farm Preparation

- Clean and disinfect housing prior to chick arrival.
- Houses should be preheated for a minimum of 24 hours prior to chick arrival.
- Recommended environmental conditions at placement are:
  - -- Air temperature: 30°C (86°F) measured at chick height in the area where feed and water are positioned.
  - -- Litter temperature: 28-30°C (82.4-86.0°F).
  - -- Relative humidity (RH): 60-70%.
- Spread litter material evenly.

Situation	Litter Depth
• Ideal brooding set-up and brooding conditions • No issue with litter disposal • Temperate climate	**5-10 cm (2-4 in)**
• Ideal brooding set-up and brooding conditions • Problems with litter disposal • Temperate climate	**5 cm (2 in)** Below 5 cm (2 in) not recommended: • Does not provide adequate insulation from cold house floors • Will have poorer moisture absorption • Will result in increased contact with manure
• Ideal brooding set-up and brooding conditions • No issue with litter disposal • Cold climate	**Up to 10 cm (4 in)** • Provides greater insulation against cold floors

- Make feed and water available to the chicks immediately.

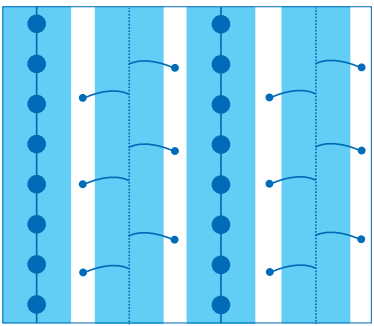
Typical spot brooding layout (per 1000 chicks).



KEY

- *80% Paper Cover*
- *Automatic Pan Feeders*
- *Nipple Line*
- *Mini-drinker*

Typical layout of a whole-house brooding system.



KEY

- *80% Paper Cover*
- *Automatic Pan Feeder*
- *Nipple Line*
- *Mini-drinker*

- Install nipple lines at 12 birds per nipple and bell drinkers at a minimum of 6 drinkers per 1,000 chicks.
- Provide feed as a dust-free crumble or mini-pellet on feeder trays (1 per 100 chicks) and/or on paper (occupying at least 80% of the brooding area).
- Chicks from different parent sources should be brooded in separate areas within the house.

Chick Placement

- Unload chicks and place them quickly onto paper in the brooding area.
- Leave chicks to settle for 1-2 hours with access to feed and water.
- Check feed, water, temperature, and humidity after 1-2 hours and adjust where necessary.
- Approximately 40 g (1.5 oz) of feed per bird should be placed in flat trays or on paper and automatic feeding systems flooded with feed.

Chick Quality

Example of good quality chicks.

- **Clean after hatch.**
- **Stand firmly and walk well.**
- **Alert and active.**
- **Free of deformities with the yolk sac fully retracted and have a healed navel.**
- **Vocalize contentedly.**

Chick Vent Temperature

PROCEDURE

Measuring Chick Vent Temperature

1. Measure vent temperature on at least 5 chicks from at least 3 different locations of the house for the first 4-5 days after placement.
2. Pay attention to cold or hot areas of the house (for example walls or under brooders).
3. Gently pick the chick up and hold it so that the vent is exposed, put the tip of the ThermoScan® thermometer onto the bare skin and record the temperature.
4. Do not take the vent temperature of chicks with wet or dirty vents.

The ideal chick body temperature for the first 4-5 days after hatching is 39.4-40.8°C (103-105°F).

Brooding Management

The First 10 Days

- If paper does not disintegrate naturally it should be removed from the house from day 3 onwards.
- Brooding rings, if used, should gradually be expanded from 3 days of age and removed completely by 5-7 days of age.
- Top up the feed on the paper/feed trays at regular intervals during the first 3-4 days of age.
- Birds should be on the main feeding system by 6-7 days of age.
- Gradually change to a good quality pellet once transfer to the main feeding system is complete. Do not give full pellets (3-4 mm) before 18 days of age.

MANAGEMENT FUNDAMENTAL

Monitor chick behavior to ensure brooding conditions are correct.

Monitor Chick Behavior

Environmental conditions correct: chicks will spread evenly throughout the brooding area - **NO ACTION REQUIRED**.

Environmental conditions are too cold: chicks grouped together under heaters or within the brooding area - **INCREASE TEMPERATURE AND/OR RELATIVE HUMIDITY**.

Environmental conditions are too hot: chicks are crowded near the house walls or brooding surrounds, away from heating sources and/or they are panting - **DECREASE TEMPERATURE AND/OR RELATIVE HUMIDITY**.

Environment

The following table shows the dry bulb temperatures required to achieve equivalent temperatures at varying RH. Dry bulb temperatures at the ideal RH at an age are colored red.

	Dry Bulb Temperature at RH%* °C (°F)				
Age (days)	**40**	**50**	**60**	**70**	**80**
Day-old	36.0 (96.8)	33.2 (91.8)	30.8 (84.4)	29.2 (84.6)	27.0 (80.6)
3	33.7 (92.7)	31.2 (88.2)	28.9 (84.0)	27.3 (81.1)	26.0 (78.8)
6	32.5 (90.5)	29.9 (85.8)	27.7 (81.9)	26.0 (78.8)	24.0 (75.2)
9	31.3 (88.3)	28.6 (83.5)	26.7 (80.1)	25.0 (77.0)	23.0 (73.4)
12	30.2 (86.4)	27.8 (82.0)	25.7 (78.3)	24.0 (75.2)	23.0 (73.4)
15	29.0 (84.2)	26.8 (80.2)	24.8 (76.6)	23.0 (73.4)	22.0 (71.6)
18	27.7 (81.9)	25.5 (77.9)	23.6 (74.5)	21.9 (71.4)	21.0 (69.8)
21	26.9 (80.4)	24.7 (76.5)	22.7 (72.9)	21.3 (70.3)	20.0 (68.0)
24	25.7 (78.3)	23.5 (74.3)	21.7 (71.1)	20.2 (68.4)	19.0 (66.2)
27	24.8 (76.6)	22.7 (72.9)	20.7 (69.3)	19.3 (66.7)	18.0 (64.4)

*Temperature calculations based on a formula from Dr. Malcolm Mitchell (Scottish Agricultural College).

Note: Chicks from donor flocks of less than 30 weeks will require a start temperature +1°C or 2°F warmer than the given temperature profile in the table above.

- Monitor temperature and relative humidity regularly (twice daily in the first 5 days and daily thereafter) and check automatic equipment with manual measurements at chick level.
- Calibrate automatic equipment at least once per crop.

MANAGEMENT FUNDAMENTAL

Establish a minimum ventilation rate from day one to provide fresh air and remove waste gases and help maintain temperatures and RH at the correct level.

Avoid drafts.

Use chick behavior and chick vent temperatures to determine if environmental conditions are correct.

Chick Start Assessment

PROCEDURE

Crop Fill

1. Collect 30-40 chicks at 3-4 different places in the house (or surround where spot brooding is used).
2. Gently feel the crop of each chick:
   -- Full soft and rounded – chicks have found feed and water.
   -- Full but hard with original feed and texture felt – chicks have found feed but little or no water.

The chick on the left has a full, rounded crop while the chick on the right has an empty crop.

Target crop fill assessment guidelines.

Time of Crop Fill Check After Placement	Target Crop Fill (% of Chicks with Full Crops)
2 hours	75
8 hours	>80
12 hours	>85
24 hours	>95
48 hours	100

MANAGEMENT FUNDAMENTAL

Crop fill should be assessed and monitored during the first 48 hours, but achieving the correct crop fill in the first 24 hours is most critical.

If target levels of crop fill are not being achieved then something is preventing the chicks from feeding and drinking and action must be taken.

Section 2

Provision of Feed and Water

Objective

To provide the broiler's lifetime nutrient requirements through appropriate broiler nutrition and broiler feeding programs so that the biological performance is maximized without compromising bird welfare or the environment.

Pages	Contents	*Handbook Reference Page*
18	Feeding Program	*27*
19	Feed Form and Physical Quality	*28*
22	Whole Grain Feeding	*31*
22	Feeding Under Hot Environmental Conditions	*32*
23	Drinking Systems	*34*
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Feeding Program

Feed	Age Fed	Comments
Starter	**0-10 days** (but can be fed for up to 14 days if target weights not achieved)	A good quality starter feed will support early growth and physiological development, ensuring target weights, good health and welfare are achieved. Starter formulations should be based primarily on promoting good biological performance and profitability, not feed costs.
Grower	**11-25 days**	Transition from starter to grower feed involves a change in texture and nutrient density and needs to be managed carefully to avoid loss of performance.
Finisher	**After 25 days of age**	Finisher feeds account for most of the total feed intake and cost of feeding a broiler, and must be designed to optimize financial return for the type of product mix being produced. Broilers fed beyond 42 days of age will require an additional finisher feed.

- Diets should be regularly sampled and the samples analyzed to ensure that the diets are as they should be.

Withdrawal Periods

- A Withdrawal feed will be required when regulated pharmaceutical feed additives are used.
- Refer to local legislation to determine the withdrawal time required.
- Extreme dietary nutrient reductions are not recommended during the withdrawal period.

Separate Feeding of Male and Female Broilers

- Feed the same feed to both sexes.
- Keep the duration of starter feed the same for both sexes.
- Shorten the feeding period of grower and finisher for females.

Feed Form and Physical Feed Quality

Ideal physical feed form and size are given in the table below.

Age	Feed Type	Feed Form and Size
0-10 days	Starter	Sieved crumble: 1.5-3.0 mm diameter or Mini-pellets: 1.6-2.4 mm diameter, 1.5-3.0 mm length
11-18 days	Grower (this is normally the first delivery of grower feed)	Sieved crumble: 1.5-3.0 mm diameter or Mini-pellets: 1.6-2.4 mm diameter, 4.0-7.0 mm length
19-24 days	Grower	Pellets: 3.0-4.0 mm diameter, 5.0-8.0 mm length
25 days to processing	Finisher	Pellets: 3.0-4.0 mm diameter, 5.0-8.0 mm length

The pictures below illustrate what a good quality sieved crumble, pellet, and mash feed should look like.

Chick starter - sieved crumb.

Good quality pellet.

Mash feed.

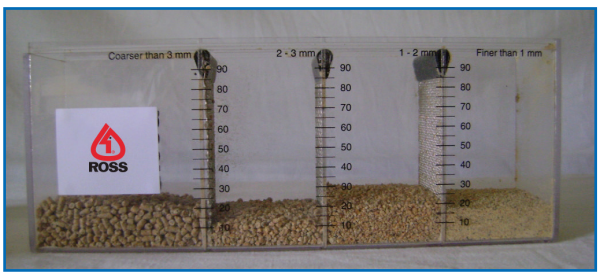
MANAGEMENT FUNDAMENTAL

Poor physical feed form will have a negative impact on broiler performance.

Particle Size Profile

Physical feed quality can be assessed using a shaker sieve.

The Ross feed physical quality testing shaker sieve.



The recommended particle size distributions for crumbles and pellets are shown in the table below.

Form	Starter	Grower	Finisher
	Crumb	Pellet (3.5 mm)	Pellet (3.5 mm)
> 3 mm	15%	>70%	>70%
> 2 mm	40%	20%	20%
> 1 mm	35%		
< 1 mm	**< 10%**	**< 10%**	**< 10%**

For mash feed particle size distributions are given below. The aim is to minimize the amount of particles <1 mm.

Particles	Coarse Mash
>3 mm	25%
2–3 mm	25%
1–2 mm	25%
<1 mm	**<25%**

Whole Grain Feeding

- If whole grain (wheat, oats or barley) is added to the feed, the diet must be formulated to balance for the inclusion of that grain so that the final nutrient composition is at recommended levels.
- Safe inclusion guides of whole grain are given in the table below.

Ration	Inclusion Rate of Whole Grain
Starter	Zero
Grower	Gradual increase to 15%
Finisher	Gradual increase to 20%

- The grain being fed must be of good quality and free from fungal/toxin contamination.
- Whole grain must be removed from the feed two days before catching.

Feeding Under Hot Environmental Temperature Conditions

- Ensure birds have access to feed during the cooler part of the day.
- Provide good quality cool water.
- Consider the strategic use of vitamins and electrolytes to help the birds deal with heat-related environmental stresses.

Drinking Systems

Drinker Type	Requirements
Nipple Drinkers	<3 kg (6.6 lbs) 12 birds per nipple >3 kg (6.6 lbs) 9 birds per nipple
Bell Drinkers	10 drinkers (40 cm / 17 in) per 1000 birds

- Birds should have access to clean, fresh, good quality drinking water 24 hours a day.
- Monitor the feed to water ratio daily.
- At 21°C (70°F), birds are consuming sufficient water when the ratio of water volume (l) to feed weight (kg) remains close to:
  - -- 1.8:1 for bell drinkers.
  - -- 1.7:1 for nipple drinkers with cups.
  - -- 1.6:1 for nipple drinkers without cups.
  - -- The water to feed ratio may be higher than this for the first few days.
- Ideal water temperature should be between 15°C (59°F) and 21°C (70°F).
- Provide supplementary drinkers for the first 4 days of a flock's life.
- Adjust drinker heights daily.

Correct nipple drinker height adjustment with bird age.

Initially, the back of the chick should form an angle of 35-45° with the floor.

As the bird grows, an angle of approximately 75-85° with the floor is correct.

Correct height of bell drinker.

- Place bell drinkers throughout the house.
- Broilers should not have to travel more than 2 m (6.6 ft) to get water.
- Water level should be 0.6 cm (0.2 in) below the top of the drinker until ten days of age.
- After ten days there should be 0.6 cm (0.2 in) of water in the base of the drinker.

- Keep drinkers well-maintained and clean.
- In hot weather, water consumption will be increased and drinker lines should be flushed at regular intervals to keep water cool.

Feeding Systems

Feeding space per bird for different feeder types.

Feeder Type	Feeder Space
Pan feeders	45-80 birds per pan (the lower ratio for bigger birds)
Flat chain/auger	2.5 cm/bird (40 birds/m of track) 1 in/bird (24 birds/ft of track)
Tube feeders	70 birds/tube (for a 38 cm/15 in diameter feeder)

- Adjust feeder height daily so that the birds' breasts are level with the base of the feeder.

Correct height of feeders.

- Feed must be distributed equally and uniformly throughout the feeding system.
- Allow the birds to clear the feeders once daily.
- Feeder space may need to be increased if the lighting program is modified.

Section 3

Health and Biosecurity

Objective

To achieve hygienic conditions within the poultry house, and to minimize the adverse effects of disease. To attain optimum performance and bird welfare, and to provide assurance on food safety issues.

Pages	Contents	*Handbook Reference Page*
26	Bird Health and Biosecurity	*55*
30	Decreasing the Risk of Disease	*64*
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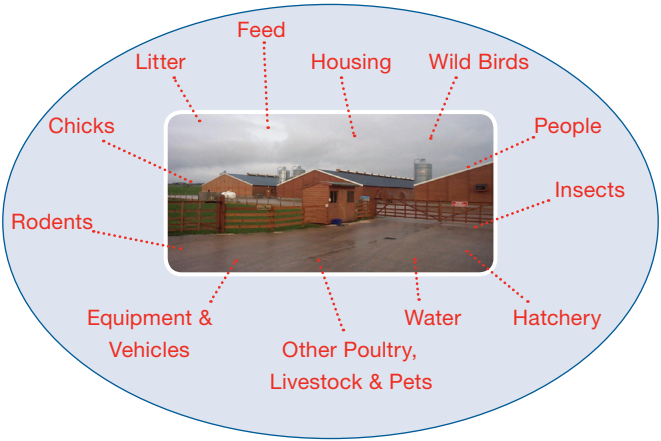
Bird Health and Biosecurity

Potential routes of disease exposure.



Cleaning

PROCEDURE

Site Cleaning

1. Plan – dates, times, labor, and equipment requirements.
2. Insect control – spray litter, equipment, and all surfaces with a locally recommended insecticide as soon as the flock has depleted or 2 weeks prior to depletion. A second treatment should be completed prior to fumigation.
3. Remove dust.
4. Pre-spray throughout the inside of the house with a detergent solution.
5. Remove equipment.
6. Remove and dispose of litter.
7. Wash using a pressure washer with foam detergent and rinse with hot water.
8. Thoroughly clean staff facilities and staff equipment as well.
9. Ensure all external areas are thoroughly cleaned.

PROCEDURE

Cleaning the Water System

1. Drain pipes and header tanks.
2. Flush lines with clean water.
3. Scrub header tanks to remove scale and biofilm deposit and drain to the exterior of the house.
4. Make up header tank to normal operating level with additional sanitizer solution at appropriate strength. Replace lid.
5. Run a sanitizer solution through the drinker lines from the header tank ensuring there are no air locks.
6. Allow disinfectant to remain for a minimum of 4 hours.
7. Drain and rinse with fresh water.
8. Refill with fresh water prior to chick arrival.

PROCEDURE

Cleaning the Feeding System

1. Empty, wash, and disinfect all feeding equipment.
2. Empty bulk bins and connecting pipes, and brush-out where possible. Clean out and seal all openings.
3. Fumigate wherever possible.

Disinfection

- Disinfection should take place once all cleaning and repairs are done.
- Use an approved disinfectant and follow manufacturers' instructions at all times.
- Apply disinfectant using either a pressure-washer or a backpack sprayer.
- If using a selective coccidial treatment, this should be applied to all clean internal surfaces and be used by suitably trained staff only.

Formalin Fumigation

- Fumigation is hazardous to animals and humans and is not permitted in all countries. Where it is permitted it must be conducted by trained personnel following local safety legislation and guidelines.
- Fumigation should be undertaken as soon as possible after disinfection has been completed.
- Surfaces should be damp, the house warmed to a minimum of 21°C (70°F) and RH greater than 65%.
- After fumigation, keep the house sealed for 24 hours with NO ENTRY signs clearly displayed.
- The house must be thoroughly ventilated before anyone enters. Formalin levels must be less than 2 ppm before anyone enters the house.
- After clean litter has been spread, fumigation should be repeated.

Evaluation of Farm Cleaning and Disinfection Efficiency

- Bacterial counts and salmonella isolations should be completed at least once a flock to determine the effectiveness of cleaning.

Water Quality

Ideal water quality criteria for poultry.

Criteria	Concentration (ppm)
Total Dissolved Solids	0-1000
pH	6.5-8.5
Sulphates	50-200
Chloride	250
Potassium	<300
Magnesium	50-125
Nitrate Nitrogen	10 (maximum level)
Nitrates	trace
Iron	<0.3
Fluoride	2 (maximum level)
Bacterial Coliforms	0 cfu/ml
Calcium	600 (maximum level)
Sodium	50-300

- Test water quality at least once a year (more often if there are perceived water quality issues or performance problems).
- Chlorination - to give between 3 and 5 ppm free chlorine at the drinker level is usually effective in controlling bacteria but this is dependent on the type of chlorine component used.
- Where hard water is a problem (iron levels > 3 mg/l), water should be filtered using a 40-50 micron filter.
- It is a good idea to routinely check the water supply on farm during a flock:
    - -- Run water out of the end of each line.
    - -- If there is a high level of particulate matter visible to the eye, action should be taken.

Decreasing the Risk of Disease

Preventing Diseases Transmitted by Humans

- Prevent unauthorized access to the farm.
- Shower on to the farm and change clothing.
- Maintain a record of visitors.
- Wash and sanitize hands and boots when entering and leaving houses.
- Clean and disinfect all equipment before bringing in to the house.
- Visit youngest flocks first.

Preventing Diseases Transmitted by Animals

- Whenever possible, use an "all in/all out" placement cycle.
- Downtime between flocks will reduce contamination of the farm.
- Do not leave equipment, building materials or litter lying around.
- Clean-up feed spills as soon as they occur.
- Store litter material in bags or inside a storage building or bin.
- Ensure all buildings are adequately sealed against access by wild birds or vermin.
- Maintain an effective rodent/vermin control program.

Vaccination

- Vaccination programs must be based on local disease challenges and vaccine availability.
- Vaccination alone cannot protect flocks against overwhelming disease challenges and/or poor management and biosecurity practices.
- Every bird must receive the intended dose of vaccine.

Disease Investigation

The tables below highlight examples of mortality parameters possibly related to bird quality and bird health giving potential investigative actions.

Troubleshooting common issues in the 0-7 day brooding phase.

Observe	Investigate	Likely Causes
Poor Chick Quality: Increased dead on arrivals (D.O.A.) Chicks inactive and slow to respond, lacking energy General chick appearance: --Unhealed navels --Red hocks/beaks --Dark wrinkled legs --Discolored or malodorous yolks or navels	**Feed, Sanitation, Air, and Water:** Source flock health and hygiene status Egg handling, storage, and transport Hatchery sanitation, incubation, and management Chick processing, handling, and transport	Inadequate diet of source flock Health and hygiene status of source flock, hatchery, and equipment Incorrect parameters for egg storage, relative humidity, temperatures, and equipment management Incorrect moisture loss during incubation Incorrect incubation temperature Dehydration caused by excessive spread of hatch time or late removal of chicks

Continued

Observe	Investigate	Likely Causes
Small Chicks Days 1-4	**Feed, Light, Air, Water, and Space:** Crop fill at 24 hours post chick placement Availability and accessibility to feed and water Bird comfort and welfare	 Less than 95% of chicks with adequate crop fill by 24 hours post placement Weak chicks Inadequate feeders and drinkers Inadequate feed and water levels Equipment location and maintenance issues Inappropriate brooding temperature and environment
Runted and Stunted Chicks: Small birds, as early as 4-7 days	**Feed, Light, Litter, Air, Water, Space, Sanitation, and Security:** Flock source Hydration status of chicks Brooding conditions Feed quality and accessibility Downtime between flocks Disease challenge	 Chicks sourced from widely different flock ages Chicks unable to find or reach water Incorrect brooding temperatures Chicks unable to find feed or poor feed quality Short downtimes between flocks Inadequate cleaning and disinfection Disease Poor biosecurity and hygiene practices

Troubleshooting common issues after 7 days of age.

Observe	Investigate	Likely Causes
Disease: Metabolic Bacterial Viral Fungal Protozoal Parasitic Toxins	**Feed, Light, Litter, Air, Water, Space, Sanitation, and Security:** Broiler farm hygiene Local disease challenge Vaccination and disease prevention strategies Feed quality and supply Lighting and ventilation	 Poor environmental conditions Poor biosecurity High disease challenge Low disease protection Inadequate or improper implementation of disease prevention Poor feed quality Poor bird access to feed Excessive or insufficient ventilation
Stress	**Potential stressors:** Temperature Management Immunosuppressive disorders	 Inadequate farm management Inadequate equipment Inadequate bird comfort and welfare

Continued

Observe	Investigate	Likely Causes
High Number of Birds D.O.A. Processing Plant:	**Feed, Light, Litter, Air, Water, Space, Sanitation, and Security:**	
High plant condemnation rate	Flock records and data	Health issues during grow-out
	Health status of flock	Management of relevant historical events affecting bird health and welfare
	History of flock during the grow-out period (such as feed, water or power outages)	Improper bird handling and hauling by crews
	Potential equipment hazards on the farm	Harsh conditions (weather or equipment related) during handling, catching, or transport to the processing plant
	Bird handling by the catchers, handlers, and transporters	
	Experience and training level of individuals handling and transporting birds	
	Conditions during catching and transporting (such as weather and equipment)	

Disease Recognition

The table below highlights some of the ways in which signs of disease can be recognized.

Observations by Farm Personnel	Farm and Laboratory Monitoring	Data and Trend Analysis
Daily assessment of bird behavior Bird appearance (such as feathering, size, uniformity, coloring) Environmental changes (such as litter quality, heat or cold stress, ventilation issues) Clinical signs of illness (such as respiratory noise or distress, depression, fecal droppings, vocalization) Flock uniformity	Regular farm visitation Routine post-mortem examinations of normal and diseased birds Proper sample collection size and type Proper choice of subsequent analysis and actions following post-mortem examination - needs validation/ clarification Routine microbiological testing of farms, feed, litter, birds, and other appropriate material Appropriate diagnostic testing Appropriate serology	Daily and weekly mortality Water and feed consumption Temperature trends D.O.A. after placement on the farm or after arrival at the processing plant Condemnation at processing

Section 4

Housing and Environment

Objective

To provide an environment that permits the bird to achieve optimum performance in growth rate, uniformity, feed efficiency and yield, while ensuring that the health and welfare of the bird are not compromised.

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Air Contaminants

Effects of common broiler house air contaminants.

Observe	Investigate
Ammonia	Ideal level < 10 ppm Can be detected by smell at 20 ppm or above. >10 ppm will damage lung surface. >20 ppm will increase susceptibility to respiratory diseases. >25 ppm may reduce growth rate depending upon temperature and age.
Carbon Dioxide	Ideal level <3,000 ppm >3,500 ppm causes ascites. Carbon dioxide is fatal at high levels.
Carbon Monoxide	Ideal level 10 ppm >50 ppm affects bird health. Carbon monoxide is fatal at high levels.
Dust	Damage to respiratory tract lining and increased susceptibility to disease. Dust levels within the house should be kept to a minimum.
Humidity	Ideal level 50-60% after brooding Effects vary with temperature. At >29°C (84.2°F) and >70% relative humidity, growth will be affected. Relative humidity <50%, particularly during brooding, will affect growth.

MANAGEMENT FUNDAMENTAL

Evaluating bird behavior is the best way to verify if ventilation settings are correct.

Housing and Ventilation Systems

Natural Ventilation: Open-Sided Housing

- Naturally ventilated houses require continuous 24 hour management.
- Monitor both ambient conditions and the conditions within the house.
- Adjust curtains or sidewall flaps in response to any changes in environment.
- During periods of cold weather, use circulation fans to enhance temperature control but beware of too much air movement at bird level.
- During hot weather, use circulation fans mounted near the side walls to draw cooler, less humid air into the house.
- When using a fogging system:
  - -- Monitor humidity levels closely to ensure they do not become too high.
  - -- Ensure good air movement is maintained.

Controlled Environment Housing

- Closed environment broiler houses should be equipped to meet the demands of the 3 stages of ventilation.
  - -- Minimum ventilation.
  - -- Transitional ventilation.
  - -- Tunnel ventilation.

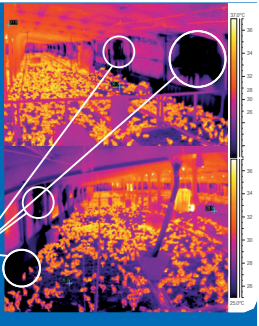
Negative pressure ventilation systems (controlled environment housing).

Achieve good airflow and volume

- If incoming airflow speed and volume is too low:
  - Cold air will drop directly on to the birds/litter
  - Litter will become wet and birds may get chilled

Ensure house is tightly sealed

- Ventilation only works effectively if the house is adequately sealed.
- This ensures the speed at which air enters the house is controlled.
- Avoid air leaks.



Uniform air inlet openings

- Open air inlets must be evenly distributed through the house and be opened equally.
- This will create uniform:
  - Volume of airflow
  - Speed of airflow
  - Direction of airflow
  - Distribution of airflow
- At lower ventilation rates close some inlets to force the same volume of air through fewer inlets.

Monitor and evaluate regularly

- Monitor house pressure & air speed:
  - Pressure should be 30-40 Pa (0.12-0.16 inches of water column) depending on house width
  - Air speed around 4 m/sec (800 ft/min) measured at air inlet
- Use smoke tests to confirm if airflow direction and inlet settings are correct.
- Monitor bird behavior and litter quality.
- Complete regular evaluation of:
  - Air quality
  - RH
  - Signs of condensation
  - Dust levels

PROCEDURE

Evaluating Negative Pressure of Controlled Environment Housing

1. Close all doors and inlets in the house.
2. Switch on one 122 cm/127 cm (48 in/50 in) fan, or two 91 cm (36 in) fans.
3. The pressure within the house should measure about 37.5 Pa (0.15 inches of water column).

Minimum Ventilation

- A minimum amount of ventilation must be given at all times.
- Minimum ventilation is used for young chicks', nighttime, or cool weather ventilation.
- Minimum ventilation should be timer not temperature driven.
- Ensure negative pressure is high enough to direct cold incoming air up to the apex of the house roof so it can warm and circulate before dropping to bird level.
- Air inlets should be opened a minimum of 5 cm (2 in) to ensure adequate air movement.

Transitional Ventilation

- Total side wall inlet capacity should be enough to allow 40-50% of the total tunnel fan capacity to be used.

Tunnel Ventilation

- Only use in warm to hot weather or where large birds are being grown.
- Ensure side wall fans are turned off (if they were used during transitional ventilation).
- Ensure side wall inlets are closed.
  - -- All air entering the house should enter through the tunnel inlets only.
- Installation of migration fences every 33 m (100 ft) should be considered.

Evaporative Cooling

- Keep fans, foggers, evaporators, and inlets clean.
- Too much water on a cooling pad in the initial stages of use will decrease house temperature too quickly.
- The cooling pump should be run on a cycle (On/Off) to allow better control of temperature.
- Ensure that the correct pressure is achieved for the type of fogging system used:
  - -- Low Pressure, 7-15 bar (102-218 psi); droplet size up to 30 microns.
  - -- High pressure, 28-41 bar (406-595 psi); droplet size 10-15 microns.
  - -- Ultra high pressure (misting), 48-69 bar (696-1001 psi); droplet size 5 microns.
- Evaporative cooling adds moisture to the air and increases relative humidity. To ensure bird welfare, operate the system based on relative humidity as well as dry bulb temperature.
- Ensure that the correct air speed is maintained when using an evaporative type cooling system.

Lighting

- The exact lighting program given will depend on local legislation, individual flock circumstances, and market requirements, but the following recommendations will benefit bird welfare and biological performance:
  - -- From 0-7 days of age, chicks should have 23 hours light and 1 hour dark.
  - -- After 7 days, a period of darkness of 4-6 hours will be beneficial.
- Changes to the lighting program should be made over a period of 2-3 days.
- Dawn to dusk programs will result in less crowding at the feeder.
- Intermittent lighting programs should be simple providing at least one continuous block of 4 hours darkness. Adequate feeder and drinker space must be provided.
- Local legislation for light intensity must be followed but as a minimum:
  - -- Provide 30-40 lux (3-4 foot candles) to 7 days of age.
  - -- Provide at least 5-10 lux (0.5-1.0 foot candles) after 7 days of age.
- During the dark period, light intensity must be less than 0.4 lux (0.04 foot candles).
- Light must be uniformly distributed throughout the house and light seepage into the house prevented.

Litter Management

Causes of poor litter quality.

Stocking Density

- Follow local legislation and requirements of quality assurance standards set by product purchasers.
- Ensure ventilation and feeder and drinker space is appropriate for stocking density.

Section 5

Monitoring Live Weight and Uniformity of Performance

Objective

To assess live flock performance by regularly weighing birds and comparing against targets to ensure that defined end-product specifications are as closely met as possible.

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44	Manual Weighing	98
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46	Inconsistent Weight Data	100

Manual Weighing

- When weighing birds manually, birds should be weighed regularly and at the same time of day.
- On each occasion, equal sized samples of birds should be taken from at least 3 locations in each house or pen.

Bulk Bird Weighing

- Between 0 and 21 days, birds should be weighed as a bulk population.
- A minimum of 100 birds (or 1% of the population, whichever is larger) should be weighed each time.

PROCEDURE

Bulk Bird Weighing

1. Suspend the scales with bucket or weighing vessel attached above the pen in a secure place and set to "zero".
2. Sample birds from at least 3 evenly distributed locations throughout each house, sample points should be away from doors and walls.

Example of bird sample points for weighing. The red circles show where a sample of birds should be taken.

3. Calmly and correctly handle birds, count and place them into the weighing vessel until it has the desired number of birds in it (10-20 birds depending on the size of the vessel).
4. Place the weighing vessel back onto the scales, wait until it is still, and record the bulk weight from the scale and bird count before releasing the birds back into the main house area.
5. Repeat this process until ALL birds in the sample within the catching pen have been weighed (this will eliminate any selective bias).
6. When all sample birds in the house have been weighed, add all recorded weights together and divide by the total number of birds weighed to give the average bird weight for that house.

Individual Bird Weighing

- Individual birds should be weighed from 21-28 days onwards, depending on age of processing.
- Birds should be caught using a catching frame or pen.

PROCEDURE
Individual Bird Weighing

1. Scales should be suspended above the pen in a secure place and set to "zero" with a 'shackle' in place for holding the birds firmly during the weighing process.
2. A minimum of 100 birds (or 1% of the population whichever is larger) should be weighed each time.
3. All birds in the catching pen must be weighed to eliminate selective bias.
4. Once all sample birds have been weighed in the house, calculate average live-weight and CV% for each house.

Automatic Weighing Systems

- Readings from any auto-weigher should be regularly checked for usage rate (number of completed weights per day) and the mean live weights achieved should be cross-checked by manual weighing at least once per week.
- Inaccurate live weight estimation will result from small sample sizes:

  -- Check weigher location.

Inconsistent Weight Data

If a sample weighing produces data that are inconsistent with the previous weights or expected gains, a second sample of birds should be weighed immediately. This will confirm whether or not there is a problem and identify potential issues (e.g. improper sampling procedures, drinker failures, or disease) needing to be resolved.

Section 6

Pre-Processing Management

Objective

To manage the final phase of the production process so that broilers are transferred to the processor in optimum condition, ensuring that the processing requirements are met and high standards of bird welfare are maintained.

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50	Transport	*110*

Preparation for Catching

- Allow 3 days on 23 hours light and 1 hour dark at a minimum of 5-10 lux (0.5-1.0 foot candles) prior to catching.
- It is recommended that feed is removed from the birds 8-12 hours before processing.
- Feed withdrawal period = time in house without feed + catching time + transport time + holding (lairage) time.
- The presence of watery droppings from broilers awaiting processing, watery fluid in the small intestine, and litter in the crop and gizzard all indicate excessive withdrawal times (more than 12 hours).
- The presence of feed in the crop or fecal contamination at the processing plant indicates that the feed withdrawal period has been inadequate (less than 8 hours).
- Delay the removal of drinkers for as long as possible.
- Follow statutory withdrawal periods for pharmaceutical products.

Pre-Catch

Prior to catching the following checks should be made.

Pre-Catch Check	Action
Time taken to catch and transport birds	Calculate the time taken to catch and transport birds and start the catch according to when the birds are scheduled to be processed.
Number of crates/ modules	Determine the number of crates/modules and trucks needed to transport the birds prior to catching.
Equipment	Ensure all equipment used (including vehicles, crates, fencing, and nets), is clean, disinfected, and in good condition.
Condition of ground at entrance to poultry house	Repair, compact, and level the ground at the entrance to the poultry house (and any secondary roads leading to the house) to ensure a smooth exit for the loaded trucks.
Litter	Replace wet litter to ease catching.
Feeding equipment	Remove feeding equipment from the house or reposition it to avoid obstruction to the birds or personnel (raise feeding equipment to above head height).
Penning	Within large houses, separate birds into pens.
Light intensity	Reduce light intensity during catching. Do not suddenly increase light intensity. For nighttime catching, which is preferred, light intensity within the house should be reduced to as low a level as possible that will allow the birds to be caught safely. For daytime catching, light intensity should be reduced as much as possible by the use of curtains over doors. Light intensity must however be sufficient to allow safe and careful catching. The best results are achieved when birds are allowed to settle after lights have been dimmed and when there is minimum disturbance before catching.
Ventilation	Maintain effective ventilation. The ventilation system should be monitored and adjusted carefully throughout the catching procedure to prevent heat build-up within the house and ensure adequate air movement over the birds. Birds should be monitored closely for signs of over-heating (panting).

Catch

Correct way to catch a broiler.

- Place birds carefully into the crates or modules, loading from the top down.
- The number of birds per transport crate or module is subject to local legislation. In high temperatures reduce bird numbers.
- Mechanical catching must follow the manufacturer's instructions.
- During catching main house doors should remain closed to maintain adequate negative pressure and ventilation. Monitor birds closely for signs of over-heating.
- Remove or raise obstructions such as feeders or drinkers before beginning the catching operation.
- Use partitions in large houses to avoid crowding.

Transport

- Local transport legislation must be followed.
- Vehicles must provide adequate protection from the environment and ventilation.
- Ventilation and/or extra heating should be used when necessary:
    - -- During loading.
    - -- When the vehicle is stationary.
    - -- At the holding area at the processing plant.
- Birds should not remain on the vehicle for any longer than necessary.

Appendices

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Production Records

Records required in broiler production.

Event	Records	Comment
Chick placement	Number of day-olds Flock of origin and flock age Date and time of arrival Chick quality Crop fill	Live weight, uniformity, number of dead on arrival Check crop fill percentage for age
Mortality	Daily Weekly Cumulative	Record by sex if possible Record culls and reason for culling separately Post-mortem records of excessive mortality Scoring of coccidial lesions will indicate level of coccidial challenge Record actual numbers and percentages Pay particular attention to 7-day mortality
Medication	Date Amount Batch number	As per veterinary instruction
Vaccination	Date of vaccination Vaccine type Batch number Expiry date	Any unexpected vaccine reaction should be recorded

Continued

Event	Records	Comment
Live weight	Weekly average live weight Weekly uniformity (CV%)	More frequent measurement is required when predicting processing weight
Feed	Date of delivery Quantity Feed type Feed form Date of starting feed withdrawal prior to catching	Accurate measurement of feed consumed is essential to measure FCR and to determine cost effectiveness of broiler operation Check feed quality
Water	Daily consumption Water to feed ratio Water quality Level of chlorination	Plot daily consumption in graph form, preferably per house Sudden fluctuation in water consumption is an early indicator of problems Mineral and/or bacteriological especially where bore holes or open water reservoirs are used
Environment	Temperature: • Floor temperature as well as litter temperature - daily minimum - daily maximum - during brooding, 4-5 times per day - litter during brooding - external temperature (daily) • Relative Humidity (daily) Air quality Litter quality Last calibration of equipment and by whom	Multiple locations should be monitored, especially in chick litter area Automatic systems should be cross-checked manually each day Ideally record dust, CO_2, NH_3 or as a minimum observe levels of dust and NH_3

Continued

Event	Records	Comment
Depletion	Number of birds removed Time and date of removal	
Information from processing plant	Carcass quality Health inspection Carcass composition Type and % condemnations	
Cleaning out	Total bacterial counts	After disinfection, salmonella, staphylococcus or E. coli may be monitored if required
House inspection	Record time of daily checks Make note of any bird observations	Behavior and environmental conditions
Lighting program	Dark and light period Time on and time off	Intermittent or not
Visitors	Who Why Date and reason for visit Previous farm visits (place and date)	Should be completed for every visitor to ensure traceability

Key Performance Parameters

Production Efficiency Factor (PEF)[+]

$$\frac{\textbf{Livability x Live Weight in kg}}{\textbf{Age in Days x FCR}} \textbf{ x 100}$$

e.g. Age 42 days, live weight 2,652 g, mortality 2.80%, FCR 1.75

$$\frac{97.20 \times 2.652}{42 \times 1.75} \times 100 = \textbf{351}$$

e.g. Age 46 days, live weight 3006 g, mortality 3.10%, FCR 1.83

$$\frac{96.90 \times 3.006}{46 \times 1.83} \times 100 = \textbf{346}$$

NOTES: The higher the value, the better the technical performance.

This calculation is heavily biased by daily gain. When comparing across different environments, comparisons should be made at similar ages at processing.

[+] Also referred to as European Production Efficiency Factor (EPEF)

Coefficient of Variation % (CV%)

$$\text{CV\%} = \frac{\textbf{Standard Deviation}}{\textbf{Average Body Weight}} \times \textbf{100}$$

e.g. A flock has an average body weight of 2550 g (5.62 lb) with a standard deviation around that average weight of 250 g (0.55 lb).

$$\text{CV\%} = \frac{250 \text{ g } (0.55 \text{ lb})}{2550 \text{ g } (5.62 \text{ lb})} \times 100 = \textbf{9.80}$$

NOTES: The lower the CV%, the more uniform and less variable the flock. CV% is an important tool to estimate the live weight of the flock.

Feed Conversion Ratio (FCR)

$$\textbf{FCR} = \frac{\textbf{Total Feed Consumed}}{\textbf{Total Live Weight}}$$

e.g. A sample of 10 birds has a total live weight of 31480 g (69.34 lb) and they have consumed a total feed amount of 36,807 g (81.07 lb). The average feed conversion for this sample set would be calculated as follows:

$$\text{FCR} = \frac{36807 \text{ g } (81.07 \text{ lb})}{31480 \text{ g } (69.34 \text{ lb})} = \textbf{1.169}$$

NOTES: The lower the FCR, the more efficient a bird (or sample of birds) is at converting the feed consumed into live body weight. It is especially important for broilers to have good FCR because they are often processed at a targeted live weight and customers want to get as much saleable meat as possible.

Adjusted Feed Conversion Ratio (Adjusted FCR)

$$\text{Adjusted FCR} = \text{Actual FCR} + \frac{\text{Target Body Weight - Actual Body Weight}}{\text{Factor}}$$

Depending on the units of measurement used, the factor in the above equation will change. For AH, a factor of 10 lb, 4.5 kg, or 4500 g should be used, depending on the unit of measurement. This equation provides a good estimation of adjusted FCR for broiler performance comparison. However, it is important to note that adjusting FCR to target weights beyond + or – 0.5 lb / 0.227 kg / 227 g of your actual weight can distort the comparison.

e.g (Unit is in g)

$$\text{Adjusted FCR} = \text{Actual FCR} + \frac{\text{Target Body Weight - Actual Body Weight}}{4500\ \text{g}}$$

$$\text{Adjusted FCR} = 1.215 + \frac{1350\ \text{g} - 1290\ \text{g}}{4500\ \text{g}}$$

=1.215 + (60 g / 4500 g)
=1.215 + 0.013
=1.228 Adjusted FCR

e.g (Unit is in kg)

$$\text{Adjusted FCR} = \text{Actual FCR} + \frac{\text{Target Body Weight - Actual Body Weight}}{4.5\ \text{kg}}$$

$$\text{Adjusted FCR} = 1.215 + \frac{1.350\ \text{kg} - 1.290\ \text{kg}}{4.5\ \text{kg}}$$

=1.215 + (0.06 / 4.5 kg)
=1.215 + 0.013
=1.228 Adjusted FCR

e.g. (Unit is in lb)

$$\text{Adjusted FCR} = \text{Actual FCR} + \frac{\text{Target Body Weight - Actual Body Weight}}{10\ \text{lb}}$$

$$\text{Adjusted FCR} = 1.215 + \frac{2.97\ \text{lb} - 2.84\ \text{lb}}{10\ \text{lb}}$$

=1.215 + (0.13 lb / 10 lb)
=1.215 + 0.013
=1.228 Adjusted FCR

NOTES: Adjusted FCR is a useful calculation when you want to measure how a flock is performing against a common target weight. It is also helpful when doing breed comparisons, as they can be analyzed at a specific target weight.

Problem Solving

Problem	Possible Causes	Action
High early mortality (>1% in first week)	Poor chick quality	Check hatchery practice and egg hygiene
	Incorrect brooding	Re-adjust brooders
	Disease	Post-mortems on dead chicks, take veterinary advice
	Appetite	Measure and achieve target crop fill levels Check feed availability - amount and space
High mortality (post 7 days)	Metabolic diseases (ascites, sudden death syndrome)	Check ventilation rates Check feed formulation Avoid excessive early growth rates Check hatchery ventilation
	Infectious diseases	Establish cause (post-mortem) Take veterinary advice on medication and vaccination
	Leg problems	Check water consumption Check calcium, phosphorus, and Vitamin D levels in diet Use lighting programs to increase bird activity
Poor early growth and uniformity	Nutrition	Check Starter ration - availability and nutritional and physical quality Check water supply - availability and quality
	Chick quality	Check hatchery procedures - egg hygiene, storage, incubation conditions, hatch time, transport time and conditions
	Environmental conditions	Check temperature and humidity profiles Check daylength Check air quality - CO_2, dust, minimum ventilation rate
	Appetite	Check poor stimulation of appetite - low proportion of birds with full crops
	Disease	Post-mortems on dead chicks, take veterinary advice

Continued

Problem	Possible Causes	Action
Poor late growth and uniformity	Low nutrient intake	Check feed nutritional and physical quality and formulation Check feed intake and accessibility Excessive early restriction Lighting program too restrictive
	Infectious disease	See high mortality
	Environmental conditions	Check ventilation rates Check stocking density Check house temperatures Check water and feed availability Check feeder and drinker space
Poor litter quality	Nutrition	Poor quality fats in diet Excess salts in diet Excess protein in diet
	Environment	Insufficient litter depth at start Inappropriate litter material Drinker design and adjustment (spillage problems) Humidity too high Stocking density too high Insufficient ventilation House temperature too low
	Infectious disease	Causing enteritis, take veterinary advice
Poor feed conversion	Poor growth	See poor early growth, poor late growth, high mortality Check settings/adjustments of feeders Allow birds to clear feeders twice daily Check house temperature is not too low
	High mortality (especially late mortality)	See high mortality
	Feed wastage	Check feed formulation and quality
	Environment	
	Nutrition	

Continued

Problem	Possible Causes	Action
Poor feather cover	Environment	Check house temperature is not too high
	Nutrition	Check ration for methionine and cystine content and balance
Factory downgrading	Ascites	See high mortality
	Blisters and burns (e.g. hockburn)	Check stocking density Check litter quality
	Bruises and breaks	Increase bird activity (e.g. feeding or lighting programs) Check handling procedures at weighing and catching
	Scratching	Excessive light stimulation Check handling procedures at weighing and catching Check feeder and drinker space Check access to feed and water
	Deep pectoral myopathy (also known as Oregon or Green Muscle Disease)	Birds excessively disturbed during growth, e.g. at partial depletion (thinning), weighing, etc.
	Excessive fatness	Poor feed distribution Check nutritional balance of diet Check house temperature not too high

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