novogen

novogen Brown

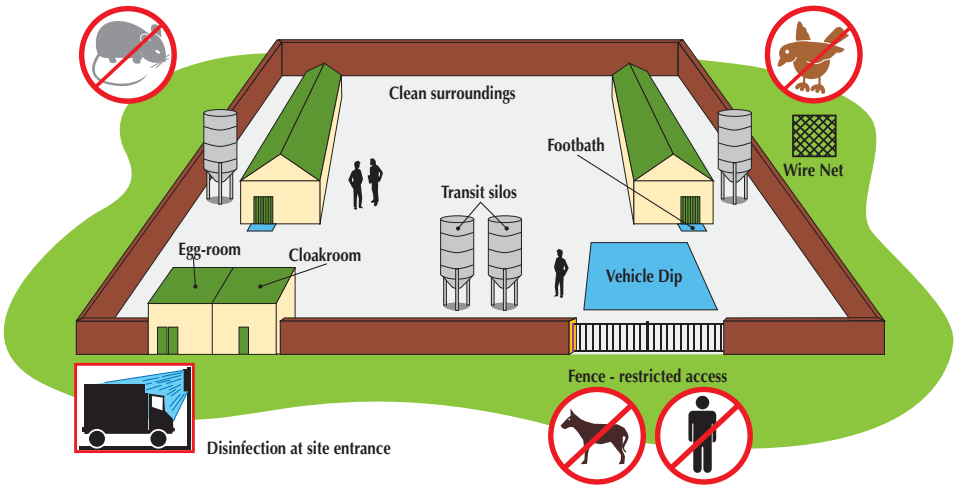
Management Guide

Parent stock

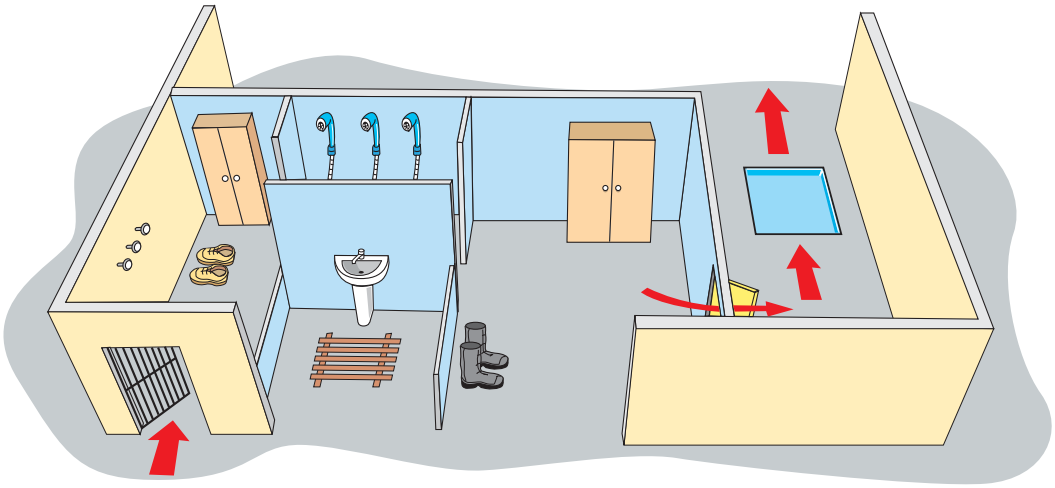
> GENERAL RULES

The golden rule of breeder management is to have one age and one breed per site to ensure the "all-in, all-out" principle is followed at all times.

The choice of the site for the farm, including the layout of the houses, must prioritise the elimination of all possible sources of contamination. Biosecurity protection is reinforced by hygiene controls.



A changing room should be made available at the entrance of the site. It must be used by everybody entering the farm (incorporating both a shower and a change of clothes).



When the old flock is removed and before the arrival of the new flock, all houses and equipment must be thoroughly cleaned and disinfected according to strict procedures and protocols. This should be followed by a rest period of at least 10 days.

> CLEANING AND DISINFECTION OF POULTRY HOUSES

Between each flock, cleaning and disinfection of the houses, their annexes, surroundings and access ways are essential to ensure the optimal health conditions required for the incoming flock to maximise its profitability.

Insect control

Depending on local regulations, the first application of an organophosphorus-type insecticide is made immediately after the old breeders have been removed while the house is still warm. The insecticide is sprayed over the pits, the litter and the lower part of the walls up to a height of 1 metre. Leave the insecticide to work for 24 hours.

Operations prior to cleaning

- Water tank, pipes and nipples:
  - empty the complete water system on the litter,
  - clean and de-scale the complete system with an acid solution and leave for 6 hours to soak,
  - rinse twice with clean water.
- All the equipment (nests, feeders, drinkers etc.) are removed and stored on a concrete area.
- The entire ventilation system (air inlets and outlets, fans, heating and ventilation ducts if they are present) and individual radiant or pancake type brooders are brushed and vacuum cleaned.
- Litter is removed.

Washing

When washing, ensure local regulations regarding wash down water are observed. As a general rule, always ensure that the dirty water is directed towards a pit or suitable internal drain and does not run outside to the house surroundings or access roads and pathways.

- House
  - Soak and remove the remaining organic matter,
  - Apply a bactericidal and fat removing detergent using an appliance capable of dealing with foam products,
  - Some hours after soaking, wash with a high pressure washer (>50 kg/cm^2) or with hot water, in the following order:
    - internal roof surfaces, from the top downwards,
    - walls, from the top downwards,
    - finally, pits and concrete floors.

- Equipment
  - Nests, drinkers and feeding equipment:
    - soak and remove all organic matter,
    - apply a bactericidal and fat removing detergent using an appliance capable of dealing with foam products,
    - ensure every piece of equipment gets a thorough wash, followed by rinsing. Prior to the final rinsing, immerse the removable parts of the nests,
    - perches and nest box bottoms for 24 hours in a disinfectant solution,
    - dry on a clean disinfected concrete area (different to that used for washing).

Placing equipment back into the house

The vehicles used for this operation must have been carefully washed and sprayed with disinfectant.

> CLEANING AND DISINFECTION OF POULTRY HOUSES

Disinfection

- Water pipes
  - Prepare a highly concentrated chlorine solution (200 ppm) in the water tank.
  - Open the tank to fill the pipes with this solution and leave for 24 hours. Afterwards, drain the water circuit. Do not forget to seal the water tank to protect it from dust.
- House
  - House and equipment disinfection is achieved using a homologous bactericidal, virucidal and fungicidal disinfectant, applied with a hand held or low pressure sprayer or a foam-producing machine.
  - The list of homologous approved disinfectants may vary from one country to another. We recommend that you consult the relevant local Authorities for a list of approved disinfectants and the required concentrations when used for poultry applications.
- Feed storage silos
  - Scrape, brush wash and after drying, fumigate using fungicidal candles following manufacturers guidelines.
- Heating and ventilation ducts (if they are present)
  - Disinfection using fungicidal, virucidal and bactericidal candles following manufacturers guidelines
- House surroundings and road and path access ways
  - Spread a disinfecting product, such as:
    - caustic soda (50 to 100 kg/1000 m^2)
    - or quicklime (400 kg/1000 m^2)

Sanitary precautions

Place clean boots and overalls in the changing room. Replenish footbaths with an appropriate disinfectant.

Rodent control

Rodents may be vectors of numerous bacterial diseases such as salmonellosis.
Rodent control is often based on the use of toxic baits which generally contain anticoagulants. These are left in places frequented by the rodents following a site risk assessment. A poorly prepared rodent control programme may give variable or poor results. We therefore advise using a specialised rodent control service.

Assessing disinfection effectiveness

- Visual examination
  - Check for dirt stains in the house and on the equipment.
- Bacteriological analysis
  - Contact plates or swabs are applied to equipment and to different places in the house. These are rapidly forwarded to a laboratory for bacteriological assessment following an agreed protocol with the laboratory.

Resting period

This starts only when all the above operations have been achieved and lasts for at least 10 days, in order for the house to dry properly.

Before the new flock arrives

- 3 days before the new flock arrives, a residual insecticide is sprayed on all surfaces.
- Fresh litter is placed (never use mouldy material) and its surface sprayed with a larvicidal insecticide.
- Equipment is prepared in the brooding area.
- 24 hours before the new flock arrives, the final disinfection is performed by fogging.

> FLOCK MANAGEMENT

Stocking density, drinker space and feeding space from day old to 2 weeks old

	MODERATE CLIMATE	HOT CLIMATE
Stocking density	20 birds/m²	20 birds/m²
Starter drinkers	1 for 80 chicks	1 for 70 chicks
Hanging drinkers	1 for 150 birds	1 for 150 birds
Nipple drinkers	1 for 12 birds	1 for 10 birds
Starting feed pans	1 for 50 chicks	
Linear chain feeders	2.5 cm per birds	
Pan feeders	1 for 30 birds	

- ***Circular brooder guards (rings or surrounds):***
  - these confine chicks to the brooding area
  - choose a diameter of 3 to 4 m at day old but ensure the ring can be enlarged 48 hours after the arrival
  - ensure the surround can be easily removed after the birds have familiarised themselves with the location of the drinker and feeder systems.

Management of the temperature during the rearing period

	Under the brooder	Near the circular guard	Room temperature
Week 1	35 - 33°C	32 - 31°C	30 - 28°C
Week 2	32°C	30 - 28°C	28 - 26°C
Week 3	28°C	28 - 26°C	26 - 24°C
Week 4			22 - 20°C
Week 5			21 - 20°C
Week 6			20 - 19°C
Week 7			19 - 18°C
Week 8			19 - 17°C
Till transfer			19 - 17°C

Check the distribution and behaviour of the chicks to adapt and manage the temperature.
Raise the house temperature at least 36 hours before chick arrival to 29°C - 30°C.

> FLOCK MANAGEMENT

Stocking density, drinker space and feeding space from 2 to 5 weeks old

	TEMPERATE CLIMATE	HOT CLIMATE
Stocking density	15 birds/m²	15 birds/m²
Hanging drinkers	1 for 100 birds	1 for 75 birds
Nipple drinkers	1 for 12 birds	1 for 10 birds
Linear chain feeders	4 cm per bird	
Pan feeders	1 for 25 birds	

Stocking density, drinker space and feeding space between 5 weeks old and transfer

	TEMPERATE CLIMATE	HOT CLIMATE
Stocking density	10 birds/m²	8 birds/m²
Hanging drinkers	1 for 100 birds	1 for 75 birds
Nipple drinkers	1 for 12 birds	1 for 10 birds
Linear chain feeders	8 cm per bird	
Pan feeders	1 for 20 birds	

- Important points:
  - Pre-heat the whole house 30 to 40 hours prior to chick arrival ensuring the floor is fully warmed before placement.
  - Never overheat the chicks and give them a choice within the desired temperature range.
  - Depending on the brooder design, place the brooders high enough above the litter (at least 1.5 m) at an angle, to allow for uniform distribution of the chicks.
  - Ensure proper ventilation from the moment the chicks arrive (minimum ventilation needs during the brooding period = 0,8 m³ per kg liveweight per hour). Unless there are cold air drafts in the house, use wire mesh fences or surrounds instead of cardboard.
  - If brooding takes place in only part of the house, do not exceed a stocking density of 25 chicks per available m². It is better to allow the chicks to spread quickly over the whole house by 7 days at the latest.

Beak trimming

- Beak trimming is sometimes undertaken where either light intensity can not be controlled due to the design of the house or when parent stock are kept at a high number of birds per square metre. The beak trimming procedure is performed to prevent feather pecking and cannibalism under these conditions and also to reduce feed wastage.
- Beak trimming is a delicate operation and should only be carried out by well-trained and experienced operators. Poor beak trimming can affect the ability of the birds to eat and drink correctly and lead to unevenness. Attention should be paid to local regulations regarding beak trimming and it is advisable to seek veterinary advice to ensure the procedures are being correctly applied.
- Beak trimming could be practiced on females at 7-10 days. On males, they may be lightly tipped. Under some specific conditions where permitted, a second debeaking may be undertaken at 8-10 weeks old on females only.

> FLOCK MANAGEMENT

- Before beak trimming:
  - check that the birds are healthy
  - do not beak trim when the birds are reacting to vaccinations
  - add vitamin K to the drinking water (to prevent haemorrhaging)
  - check that the temperature of the trimming blade is high enough to prevent haemorrhaging but not too high which may risk chicks being burned.
- To limit the effect of beak trimming on the feed consumption and water intake, it is important to increase the water level in the drinkers and the pressure in the pipes. Ensure that the depth of the feed in the feeders is correct.
- As outlined above, in addition to technical recommendations, any local code or regulation concerning animal welfare should be observed.

Monitoring bodyweight and uniformity

- The main objective is to reach the appropriate bodyweight and uniformity targets at different stages of bird development:
  - at the early stage (4 – 6 weeks: period of frame development)
  - at sexual maturity with an even growth curve (a low bodyweight at sexual maturity could affect later performance)
  - at the start of lay to the peak of production.

- ***Bodyweight control***
  - The birds must be sample weighed weekly from the first week. During the first 4 weeks, collective weights can be taken in batches of 5 or 10 birds using a bucket. Subsequently, the birds can be weighed individually.
  - From 26 weeks old, weigh the birds every 2 weeks and monthly from 32 weeks old.
  - Weigh a sufficient number of birds (around 100) cornered using lightweight screens or frames in 2 or 3 places in the house. For an accurate interpretation of the result, it is important to weigh all the birds caught in the sample. Weights can be recorded on a weighing sheet which is available from our technicians.
  - After weighing, average body weight and uniformity are calculated and immediately plotted on the growing curve chart. The analysis of the growing curve helps to accurately adjust the feed allowance (the quantities indicated in our Feed section are only to be considered as a guideline) and, when required, to take the appropriate steps to correct uniformity.

- ***Uniformity control***
  - The uniformity target is set to ensure 80 % of the body weights are in a range between within + 10 and -10 % of the flock mean body weight.
  - The following factors play an important role in achieving and maintaining good uniformity:
    - ↗ access to feed and water (see equipment standards)
    - ↗ health status of the flock
    - ↗ disease and parasitism
    - ↗ quality of beak trimming.

> FLOCK MANAGEMENT

Health programme

- It is impossible to devise a health programme to adequately suit all geographic areas. For this reason, it is strongly recommended that a local specialist be consulted to help produce a prevention programme adapted to that region.
- This guide limits its comments to the description of some rules for the use of vaccines and other treatments. To be successful, respecting these rules is as important as choosing the right products.
  - Staff should be properly trained to carry out veterinary operations. It is useful to create a Standard Operating Procedure Manual that describes in full detail the way to perform each vaccination or treatment.
  - All the necessary equipment (sprayers, syringes, etc.) must be correctly maintained, and checked before each use.
  - Each operation should be planned and supervised by a technically competent person.
  - Vaccines and treatments should be stored in appropriate conditions, in suitable quantities considering the requirements and supply time.
  - Report carefully in the flock records the details of all operations: date, time, vaccine batch number, route, etc.
  - Finally, it is useful to have the help of a laboratory in order to anticipate health problems ahead of time and to assess the efficiency of the operations:
    - control of disinfection, water and feed quality
    - serological monitoring
    - post mortem examination, routine parasite checks.

Grit and grain

We advise giving the birds grit and grain from 4 to 5 weeks of age to maintain an active feeding behaviour, to aid the development of the digestive tract and to encourage the birds to scratch the litter. This is provided as either:

- grit (insoluble stone particles of 2 to 4 mm diameter): 3 to 5 g per week per bird, distributed over 2 or 3 days
- grain (broken maize, or whole wheat): 3 g per bird every day, or every other day.

This is distributed on the litter, a few hours before the dark period.

> FLOCK MANAGEMENT

Lighting programmes

Sexual maturity and production are largely influenced by the changes in day length to which pullets are exposed. A correctly applied lighting programme will help to optimise the performance of the flock. Sexual maturity and bodyweight at sexual maturity influence egg production, egg size and liveability and so influence the total number of hatching eggs per hen housed.

To implement a lighting programme we need to consider and understand:

- Housing and climate variations including dark house, semi dark house or open house, hot or cold climate
- Period of the year (in increasing or in decreasing day length)
- Results previously obtained in the rearing house.

• *Lighting programme during the first weeks of the rearing period*

In order to encourage the frame development and growth, a slow step down lighting programme is advised for all the conditions of housing.

The decrease in artificial light duration is then adjusted according to the housing type. For an open house system, determine the natural light duration that the birds will encounter at 19 weeks. This will determine how rapidly day length can be decreased.

• *Lighting programme between 10 weeks old till 2-5 % of production*

It is important to avoid any increase of light duration during this period to control sexual maturity. It is critical to avoid early sexual maturity at an immature bodyweight.

In a dark house system, a constant light duration between 10 weeks of age and 2-5 % of production will help to avoid sexual maturity at too early an age. The light duration during that period may also be adapted according to the growth of the pullets (10, 11 or 12 hours light period could be used if growth is slow).

In an open house system, which is the most difficult system for controlling sexual maturity, the natural day length the pullets will be exposed at 19 weeks old will determine the light duration at the plateau to avoid any increase of light duration before the birds are 19 weeks old.

• *Increase of light duration from 2-5 % of production*

After the appearance of the first eggs, the increase of artificial light duration should be adjusted according to the production level. An increase of light duration of 30 minutes or 1 hour per week is suggested.

• *Light duration during production*

After the first stimulatory increase in light duration at 19 weeks, never decrease the day length during the production period. A decreasing day length will risk an early decline in egg production and poor flock performance.

• *Light intensity*

A higher light intensity during the brooding period will encourage growth by promoting higher levels of activity of the flock and a higher feed intake.

After 2 or 3 weeks and according to the behaviour of the chicks, the light intensity may be reduced to match the field conditions and the light intensity the birds will be exposed to during the production period (degree of darkness of the rearing house).

To recommend one universal optimum lighting programme for all housing styles is almost impossible. Local conditions, local times of sunrise-sunset, degree of darkness of the rearing and production houses have to be taken into account. For more specific advice, please do not hesitate to contact directly the NOVOGEN technician in your area.

> FLOCK MANAGEMENT

Lighting programme in dark houses

Age (weeks)	Age (days)	Light duration in hours	Light intensity
1	0 to 2	22.00	20 - 40 lux
1	3 to 7	20.00	20 - 30 lux
2	8 to 14	19.00	10 - 20 lux
3	15 to 21	18.00	5 - 10 lux
4	21 to 28	18.00	5 - 10 lux
5	29 to 35	17.00	5 - 10 lux
6	36 to 42	17.00	5 - 10 lux
7	43 to 49	16.00	5 - 10 lux
8	50 to 56	16.00	5 - 10 lux
9	57 to 63	15.00	5 - 10 lux
10	64 to 70	14.00	5 - 10 lux
11	71 to 77	13.00	5 - 10 lux
12	78 to 84	12.00	5 - 10 lux
13	85 to 91	11.00	5 - 10 lux
14	92 to 98	11.00	5 - 10 lux
15	99 to 105	11.00	5 - 10 lux
16	106 to 112	11.00	5 - 10 lux
17	113 to 119	11.00	5 - 10 lux
18	120 to 126	11.00	5 - 10 lux
	2 - 5% of production	12.00	5 - 10 lux
	+ 6 days	13.00	5 - 10 lux
	+ 12 days	14.00	5 - 10 lux
	+ 15 days	15.00	5 - 10 lux
	+ 18 days	16.00	5 - 10 lux
	+ 21 days	16.00	5 - 10 lux
	Till the end	16.00	5 - 10 lux
		16.00 + (1)	

(1) Midnight lighting: It is possible to use an additional 1.00 to 1.30 hours of light in the middle of the dark period in order to promote an optimal feed intake during the first weeks of production or to compensate for the adverse effect of high temperature during the summer.

This extra light period may be introduced and removed during the production period at any time after the increase in light duration at the start of lay.

> FLOCK MANAGEMENT

Lighting programme in semi - dark houses

Age (weeks)	Age (days)	Light duration in hours	Light intensity Open house	Light intensity Semi-dark house
1	0 to 2	**22.00**	20 - 40 lux	**20 - 40 lux**
1	3 to 7	**20.00**	20 - 30 lux	**20 - 30 lux**
2	8 to 14	**19.00**	20 - 30 lux	**10 - 20 lux**
3	15 to 21	**18.00**	20 - 30 lux	**10 - 15 lux**
4	21 to 28	**18.00**	20 - 30 lux	**10 - 12 lux**
5	29 to 35	**17.00**	20 - 30 lux	**10 - 12 lux**
6	36 to 42	**17.00**	20 - 30 lux	**10 - 12 lux**
7	43 to 49	**16.00**	20 - 30 lux	**10 - 12 lux**
8	50 to 56	**16.00**	20 - 30 lux	**10 - 12 lux**
9	57 to 63	**15.00**	20 - 30 lux	**10 - 12 lux**
10	64 to 70	**14.00 (or NDL)** *	20 - 30 lux	**10 - 12 lux**
11	71 to 77	**13.00 (or NDL)** *	20 - 30 lux	**10 - 12 lux**
12	78 to 84	**12.00 (or NDL)** *	20 - 30 lux	**10 - 12 lux**
13	85 to 91	**11.00 (or NDL)** *	20 - 30 lux	**10 - 12 lux**
14	92 to 98	**11.00 (or NDL)** *	20 - 30 lux	**10 - 12 lux**
15	99 to 105	**11.00 (or NDL)** *	20 - 30 lux	**10 - 12 lux**
16	106 to 112	**11.00 (or NDL)** *	20 - 30 lux	**10 - 12 lux**
17	113 to 119	**11.00 (or NDL)** *	20 - 30 lux	**10 - 12 lux**
18	120 to 126	**11.00 (or NDL)** *	20 - 30 lux	**10 - 12 lux**
	2 - 5 % of production	**+0.30**	20 - 30 lux	**10 - 12 lux**
	+6 days	**+1.00**	20 - 30 lux	**10 - 12 lux**
	+12 days	**+1.00**	20 - 30 lux	**10 - 12 lux**
	+15 days	**+1.00 (or 16.00)**	20 - 30 lux	**10 - 12 lux**
	+18 days	**+1.00 (or 16.00)**	20 - 30 lux	**10 - 12 lux**
	+21 days	**+0.30 (or 16.00)**	20 - 30 lux	**10 - 12 lux**
	Till the end	**16.00**	20 - 30 lux	**10 - 12 lux**
		16.00 (1)		

* NDL: Natural Day Length.

Situation : Please note that in order to define the optimal lighting programme for your conditions, we have to consider which of the following applies:
From dark rearing house to dark laying house
From dark rearing house to semi dark or open laying house
From semi dark or open rearing house to dark laying house
From semi dark or open rearing house to semi dark or open laying house.

> FLOCK MANAGEMENT

Equipment

	100% FLOOR	2/3 SLATS - 1/3 FLOOR	HOT CLIMATE
Stocking density (max)	6 hens/m²	8 hens/m²	6 hens/m²
Hanging drinkers	1 for 100 birds	1 for 100 birds	1 for 70 birds
Nipple drinkers	1 for 12 birds	1 for 12 birds	1 for 10 birds
Linear chain feeders (**)	5 cm per bird (*)		
Individual nests	1 for 5/6 hens		
Collective nests	1 m² for 120 hens		
Perches	5 to 10 cm per bird		

(*): 5 cm per bird means 10 cm of linear feeder space.

(**): Equipment should allow a very quick feed distribution.

Transfer

Transfer is advised around 16 to 17 weeks of age.

- Before the appearance of the 1st eggs.
- After a last vaccine planned 1 week before the transfer.
- After de-worming of the flock (3 days prior the transfer)

In order to minimize the stress at transfer time, it is important to:

- Rear the birds with similar drinking system as they will encounter after transfer.
- Increase light intensity to encourage water consumption
- Maintain temperature as close as temperature experienced by the pullets at the end of the rearing period.

Male management

Males and pullets can be reared together.

- % of males:
  - 10 to 12 % of males at day old.
  - From 15 weeks old to 5 % of production, the percentage of males can be reduced to 6 % according to the behaviour of the males. Over mature males may affect the growth of the females by reducing access to the feeders. Extra males are best kept in a separate pen.
- From 5 % egg production, males may be re-introduced (during the dark period) progressively as egg production increases to achieve
- 9 % of males during the production period.

Floor eggs

At the start of production, it is very important to collect floor laid eggs frequently. We recommend collecting every hour until the early afternoon. Floor eggs that are not removed become an incentive for other hens to lay in the same place.

During this period, the farm attendant should try to identify those hens laying on the floor and place them onto the nests.

To avoid floor egg in specific places, an electric fence around the outside of the litter or slatted areas and along the walls and partitions may be useful. It should be fixed at 5 cm from the wall and 12 cm above the litter.

Broodiness

Broodiness can occasionally appear in some flocks. It is important to identify broody females at least 2 times a week and place them in a specific dedicated pen, without nesting materials and with only slats, water and feed. Ensure the stocking density in broody pens never exceeds the stocking density in the rest of the house.

> CARE OF HATCHING EGGS

The aim is to protect embryo liveability which leads to improved hatchability and chick quality. The eggs must not be incubated before 24 weeks of age using a minimum egg weight of 51 - 52g.

Egg handling

The main risk for the embryo comes from bacterial contamination immediately after the egg has been laid. As it cools down, the egg content retracts and air enters through pores in the eggshell. If the environment (litter, nest floor) is dirty, bacteria will invade the shell and they will be difficult to kill.

Dirty nests and floor eggs are often the main reason for exploding eggs in the setters and for chick contamination by Pseudomonas and Aspergillus. The nests must therefore be maintained clean at all times

Nests should be equipped with a closing or ejection system to avoid nest occupation and staining at night.

Embryo development is reduced when ambient temperature is below 25°C and stops below 21°C - 22°C. Depending on ambient temperatures, the temperature in the nests may reach 30°C, as both the hens produce heat and litter acts as an insulating material. If eggs are left for too long in these conditions, the embryo starts to develop and becomes more sensitive to subsequent environmental change. This becomes more acute as the flock ages.

Eggs must be collected at least 4 times a day in temperate climates and more often in cold or in hot climates. Egg collection is made using either new carton trays or previously disinfected plastic or setter trays.

Egg disinfection

Hatching eggs must be disinfected quickly after collection. Various methods are available, but fumigation with formalin remains the best technique when local regulations permit.
Important points for proper fumigation:

- disinfect as quickly as possible once the eggs have been laid and are still warm
- fumigate at a temperature of 24°C, with 80% relative humidity
- use 40 ml of 30% formalin solution + 20 g of potassium permanganate, or 10 g of formalin powder, for each m^3 of space
- fumigate for 20 minutes, followed by thorough ventilation of the fumigation chamber.

When local regulations forbid the use of formalin, other methods remain available such as hydrogen peroxide, quaternary ammonium compounds, chlorine, UV rays, ozone, or dipping in a disinfectant solution. Always follow manufacturers instructions according to the treatment applied.

Egg storage

Allow eggs to cool down for one or two hours before cooling. Storage temperature may be between 15 and 18°C, depending on the length of the period the eggs will be stored.
To provide the egg room with air conditioning is an excellent investment if the temperature is likely to exceed 22°C in summer.
The following is a suggested procedure. Bring the eggs quickly to the storage room. The temperature should be 18°C with 80% R.H. for short storage periods. For longer storage periods of more than 6 days, the temperature should be about 15°C. Please note there can be a risk of condensation on the shell as eggs warm up rapidly following storage at low temperatures. This must be avoided as it may cause egg contamination.

> WATER QUALITY

Quality

- Water must be monitored on a regular basis (at least twice a year). The following table gives some microbiological and chemical standards:
- We recommend equipping each farm with a system to control the bacteriological quality of the water (chlorination for instance).

	Units	Very pure water	Drinkable water	Suspecte water	Bad water
Total flora	number/ml	0 to 10	10 to 100	1 000 to 10 000	100 000
Salmonella	number/ml	0	0	> 0	> 0
E. coli	number/ml	0	0	10 to 50	100
Hardness		5 to 15°	15 to 30°	30°	30°
Organic matter	mg/l	0	1	3	4.6
Nitrates	mg/l	0	0 to 15	15 to 30	30
Ammonia	mg/l	0	0	2	10
Turbidity			5 units		25 units
Iron	mg/l		0.3		1
Manganese	mg/l		0.1		1.5
Copper	mg/l		1		1.5
Zinc	mg/l		5		15
Calcium	mg/l		75		200
Magnesium	mg/l		50		150
Sulphates	mg/l		200		400
Chlorides	mg/l		200		600
pH		7	7 to 8.5		6.5 to 9.2

- Water sample for analysis should be taken at entry point of the house and/or at the end of the system.
- Sample once a year or twice a year.

Important

- Clean the pipe system during the sanitary break between flocks.
- Treat the drinking water with chlorination and monitor the residual active chlorine at the end of the pipe system once a week.
- Clean drinkers on a regular basis.

> NUTRITION

Nutrient recommendations per 1000 kcal (Mcal) of Metabolisable Energy (ME) for rearing period

	STARTER		GROWER		PULLET		PRELAY	
Age	0 - 35 days		36 - 70 days		71 - 112 days		113 - 5% of lay	
Suggested ME kcal/kg (1)	2900 - 3000		2800 - 2900		2700 - 2900		2700 - 2900	
Nutrient g / Mcal	**Total**	**Dig.**	**Total**	**Dig.**	**Total**	**Dig.**	**Total**	**Dig.**
Lysine	3.85	3.38	3.42	3.00	2.74	2.41	2.96	2.59
Methionine	1.75	1.62	1.50	1.44	1.24	1.14	1.43	1.32
Meth. & Cystine	2.98	2.64	2.55	2.34	2.31	2.05	2.52	2.23
Tryptophan	0.77	0.64	0.68	0.59	0.64	0.53	0.69	0.57
Arginine	4.00	3.50	3.50	3.10	3.00	2.70	3.00	2.70
Threonine	2.58	2.25	2.22	2.00	1.88	1.64	2.03	1.76
Nutrient g/Mcal	**Mini**	**Maxi**	**Mini**	**Maxi**	**Mini**	**Maxi**	**Mini**	**Maxi**
Calcium	3.6	3.8	3.6	3.9	3.5	3.9	8.1	9.3
Av. Phosphorus	1.55	1.72	1.50	1.68	1.48	1.63	1.56	1.59
Sodium	0.62	0.69	0.57	0.64	0.59	0.67	0.59	0.67
Chloride	0.55	0.69	0.57	0.71	0.59	0.74	0.59	0.74
Potassium	2.07	2.59	2.14	2.50	1.85	2.59	1.85	2.59
Linoleic acid	5.5		5.0		5.0		5.0	

(1) ME concentrations will vary according to the ingredients available locally and their cost. Lower ME concentrations are preferred where possible. To do this requires ingredients with low ME content to be available which should be of reliable nutrient concentration and free of anti nutritive factors.

Example of diet specifications for rearing period

	STARTER		GROWER		PULLET		PRE-LAY	
	Crumbs		Crumbs or mash		Coarse mash		Coarse mash	
Nutrient	**Low ME**	**High ME**	**Low ME**	**High ME**	**Low ME**	**High ME**	**Low ME**	**High ME**
ME kcal/kg (1)	**2900**	**3000**	**2800**	**2900**	**2700**	**2900**	**2700**	**2900**
ME kcal/lb	**1316**	**1361**	**1270**	**1316**	**1225**	**1316**	**1225**	**1316**
Crude Protein % (2)	20.0 - 20.5	20.5 - 21.0	18.5 - 19.0	19.0 - 19.5	16.0 - 17.0	16.5 - 17.5	16.5 - 17.0	17.0 - 17.5
Crude Fat %	3.5 - 5.0	4.0 - 5.5	3.0 - 4.5	3.5 - 5.0	2.5 - 4.0	3.0 - 5.0	3.0 - 4.5	3.5 - 5.0
Crude Fibre %	2.5 - 3.5	2.0 - 3.5	3.0 - 4.0	2.5 - 4.0	3.5 - 6.5	4.0 - 6.0	3.5 - 6.5	4.0 - 6.0
Tot Lysine %	1.12	1.16	0.96	0.99	0.74	0.80	0.80	0.86
Tot Methionine %	0.51	0.53	0.44	0.45	0.33	0.36	0.39	0.41
Tot Meth & Cystine %	0.86	0.89	0.74	0.77	0.62	0.67	0.68	0.73
Tot Tryptophan %	0.211	0.218	0.187	0.193	0.140	0.150	0.151	0.162
Tot Threonine %	0.75	0.78	0.64	0.67	0.51	0.55	0.55	0.59
Dig Lysine %	0.98	1.01	0.84	0.87	0.65	0.70	0.70	0.75
Dig Methionine %	0.47	0.49	0.40	0.40	0.31	0.33	0.36	0.38
Dig Meth & Cystine %	0.76	0.79	0.66	0.66	0.55	0.59	0.60	0.65
Dig Tryptophan %	0.185	0.192	0.164	0.170	0.143	0.154	0.154	0.165
Dig Threonine %	0.65	0.67	0.56	0.58	0.44	0.47	0.48	0.51
Calcium %	1.05 - 1.10	1.05 - 1.10	1.00 - 1.10	1.00 - 1.10	0.95 - 1.05	0.95 - 1.05	2.20 - 2.50	2.30 - 2.60
Av. Phosphorus % (3)	0.45 - 0.50	0.46 - 0.50	0.42 - 0.47	0.43 - 0.48	0.40 - 0.44	0.42 - 0.45	0.42 - 0.45	0.43 - 0.48
Sodium %	0.18 - 0.20	0.20 - 0.22	0.16 - 0.18	0.16 - 0.20	0.16 - 0.18	0.16 - 0.20	0.16 - 0.18	0.16 - 0.20
Chloride %	0.16 - 0.20	0.16 - 0.22	0.16 - 0.20	0.16 - 0.22	0.16 - 0.20	0.16 - 0.22	0.16 - 0.20	0.16 - 0.22
Potassium %	0.60 - 0.75	0.62 - 0.78	0.50 - 0.75	0.62 - 0.78	0.50 - 0.70	0.52 - 0.72	0.50 - 0.70	0.52 - 0.72
Linoleic Acid (min)%	1.50	1.60	1.40	1.50	1.30	1.40	1.30	1.40

(1) ME concentrations will vary according to the ingredients available locally and their cost. Lower ME concentrations are preferred where possible. To do this requires ingredients with low ME content to be available which should be of reliable nutrient concentration and free of anti nutritive factors.

(2) The crude protein concentrations shown are as a guide and will vary according to local ingredients. Try to avoid excess protein wherever possible.

(3) Assumes available phosphorus basis. Special care should be taken on the phosphorus value used for phytase (if used).

Nutrient recommendations per 1000 kcal (Mcal) of Metabolisable Energy (ME) for production period

	LAYER 1		LAYER 2	
Age	**From 5%**		**From 50 weeks**	
Suggested ME kcal/g (1)	**2750 - 2900**		**2720 - 2900**	
Nutrient g/Mcal	**Total**	**Dig.**	**Total**	**Dig.**
Lysine	2.85	2.50	2.81	2.46
Methionine	1.45	1.34	1.43	1.32
Meth. & Cystine	2.44	2.16	2.40	2.12
Tryptophan	0.68	0.56	0.67	0.55
Arginine	3.50	3,09	3,40	3.05
Threonine	1.98	1.72	1.95	1.69
Nutrient g/Mcal	**Mini/Maxi**	**Mini/Maxi**	**Mini/Maxi**	**Mini/Maxi**
Calcium	13.0	13.5	12.5	12.9
Av. Phosphorus	1.53	1.64	1.36	1.47
Sodium	0.58	0.65	0.58	0.65
Chloride	0.58	0.73	0.58	0.73
Potassium	2.18	2.73	2.18	2.73
Linoleic acid	5.5		4.5	

(1) ME concentrations will vary according to the ingredients available locally and their cost. Lower ME concentrations are preferred where possible. To do this requires ingredients with low ME content to be available which should be of reliable nutrient concentration and free of anti nutritive factors.

Example of diet specifications for production period

	Layer 1				Layer 2 - (3)			
	Coarse mash				Coarse mash			
Nutrient	**Low ME**		**High ME**		**Low ME**		**High ME**	
ME kcal/kg (1)	**2750**		**2900**		**2720**		**2900**	
ME kcal/lb	**1248**		**1316**		**1234**		**1316**	
Crude Protein % (2)	17.5 - 18.0		18.0 - 18.5		17.0 - 17.5		17.5 - 18.0	
Crude Fat %	3.5 - 4.5		4.0 - 5.0		3.0 - 4.0		3.5 - 4.5	
Crude Fibre %	4.0 - 6.0		3.5 - 5.0		4.0 - 6.0		3.5 - 6.0	
Daily feed cons. In g	< 108	> 108	< 104	> 104	< 115	> 115	< 110	> 110
Tot Lysine %	0.87	0.83	0.87	0.83	0.83	0.79	0.88	0.84
Tot Methionine %	0.44	0.42	0.44	0.42	0.42	0.40	0.45	0.43
Tot Meth & Cystine %	0.74	0.71	0.74	0.71	0.70	0.67	0.75	0.72
Tot Tryptophan %	0.194	0.185	0.197	0.188	0.183	0.175	0.200	0.191
Tot Threonine %	0.61	0.58	0.60	0.57	0.57	0.55	0.61	0.58
Dig Lysine %	0.77	0.73	0.76	0.73	0.72	0.69	0.75	0.71
Dig Methionine %	0.41	0.39	0.41	0.39	0.39	0.37	0.40	0.38
Dig Meth & Cystine %	0.66	0.63	0.66	0.63	0.62	0.59	0.65	0.62
Dig Tryptophan %	0.170	0.161	0.170	0.160	0.160	0.152	0.170	0.160
Dig Threonine %	0.53	0.50	0.52	0.50	0.50	0.48	0.52	0.49
Calcium %	3.55 - 3.70		3.80 - 3.90		3.40 - 3.50		3.60 - 3.80	
Av. Phosphorus % (4)	0.42 - 0.45		0.43 - 0.48		0.37 - 0.40		0.38 - 0.42	
Sodium %	0.16 - 0.18		0.17 - 0.20		0.16 - 0.18		0.17 - 0.20	
Chloride %	0.16 - 0.20		0.16 - 0.22		0.16 - 0.20		0.16 - 0.22	
Potassium %	0.60 - 0.75		0.62 - 0.78		0.60 - 0.75		0.62 - 0.78	
Linoleic acid min %	1.50	1.40	1.60	1.50	1.20	1.00	1.30	1.00

(1) ME concentrations will vary according to the ingredients available locally and their cost. Lower ME concentrations are preferred where possible. To do this requires ingredients with low ME content to be available which should be of reliable nutrient concentration and free of anti nutritive factors.

(2) The crude protein concentrations shown are as a guideline and will vary according to local ingredients. Try to avoid excess protein wherever possible.

(3) Layer 2 must have the same physical form and use similar ingredients as Layer 1 to ensure a smooth transition.

(4) Assumes available phosphorus basis. Special care should be taken on phosphorus value used for phytase (if used).

Target nutrient intakes at peak egg output

Metabolisable energy	320 kcal/day at 20°C in cage
Digestible Amino Acids	**In mg/day**
Lysine	800
Methionine	430
Methionine & Cystine	690
Tryptophan	180
Arginine	990
Threonine	550
Minerals	**In mg/day**
Calcium	4150
Available phosphorus	490

Vitamin and mineral premix recommendations

Nutrient		Starter	Starter & Grower	Pre-lay & layer
Manganese	Ppm	100	80	100
Zinc	Ppm	100	80	100
Iron	Ppm	60	60	60
Copper	Ppm	10	5	10
Selenium (2)	Ppm	0.4	0.4	0.4
Iodine	Ppm	2	1	2
Cobalt	Ppm	0.5	0.5	0.5
Vit. A	U.I./kg	15000	12000	15000
Vit. D3	U.I./kg	3000	3000	3000
Vit. E (1)	U.I./kg	60	40	60
Vit. K	mg/kg	5	2	5
Thiamine B1	mg/kg	3	2	3
Riboflavin B2	mg/kg	12	8	12
Pantothenic acid B5	mg/kg	15	10	15
Nicotinic acid B3	mg/kg	60	60	60
Pyridoxine B6	mg/kg	4	3	5
Folic acid B10	mg/kg	2	1	2
Cyanocobalamin B12	mg/kg	0.03	0.02	0.03
Biotine Vit. H (3)	mg/kg	0.20	0.15	0.20
Choline (3)	mg/kg	750	600	750

(1) The higher dose can help to increase immunity.

(2) Assumes inorganic and organic sources - check local regulations for the maximum permitted amount of selenium.

(3) Biotin levels can be reduced for standard maize and soya based diets by 0.05mg/kg and choline by 400 mg/kg.

> NOTES

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