

Management Guide

Alternative systems

NOVOgen White Light



NOVOGEN

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The performance data contained in this document was obtained from results and experience from our own research flocks and flocks of our customers. In no way does the data contained in this document constitute a warranty or guarantee of the same performance under different conditions of nutrition, density or physical or biological environment. In particular (but without limitation of the foregoing) we do not grant any warranties regarding the fitness for purpose, performance, use, nature or quality of the flocks. NOVOGEN makes no representation as to the accuracy or completeness of the information contained in this document.

1. HOUSING SYSTEMS

1.1. ALTERNATIVE SYSTEM DESCRIPTION

- Floor system:

Birds are able to move freely in the house. They have access to a litter area where they can practice their natural behavior like scratching and dust bathing. The ground surface can totally be on litter or separated between a litter and slatted area. Perches can be provided from an early age.

- Aviary system:

The system provide living space at different levels, which increases the total useable surface. Thus, more birds can be placed per m² of floor area than in floor system. The hens can freely move at floor level and vertically in the system. They can use perches and have access to feeders, drinking system, nests on different levels. The floor is covered by litter where birds can perform natural behavior.

- Free-Range:

Free range is either a floor or aviary system where birds have access to an outside area.

1.2. CHOICE OF REARING SYSTEM AND EQUIPMENT

The rearing system and equipment have to be carefully chosen according to the equipment used in the production farm.

Feeding and drinking equipment during the rearing period should be as similar as possible to the ones used in the future production system. It will facilitate the transfer and adaptation to the new production house.

For aviary systems, young pullets have to be trained for a quick adaptation after transfer to use the equipment on different levels. It is important that pullets learn to jump to or from the perches and plateforms as well as to sleep in the system during the night.

REARING SYSTEM	RECOMMENDED PRODUCTION SYSTEM
Floor	Floor / Free range
Aviary	Floor / Aviary / Free range

FLOCK MANAGEMENT DURING THE REARING PERIOD

2. FLOCK MANAGEMENT DURING THE REARING PERIOD

Rearing is a key period for successful laying performances. During this period it is necessary to reach the target bodyweight and flock uniformity to prepare the birds for the production period. In addition, pullet must be trained to optimize adaptation to production system. A special care has also to be given to the development of the digestive tract in order to prepare for the fast increase in consumption at the beginning of the production period. A well-managed rearing period has positive effects on:

- Quick adaptation to production system (onset of lay, floor eggs prevention)
- Egg production (peak of lay and persistency)
- Egg quality (egg weight, egg uniformity, shell strength)
- Liveability

To achieve those objectives, it is necessary to respect the following basics:

- Management (stocking density, drinker and feeder space, water, beak trimming...)
- Climate conditions
- Pullet training
- Lighting programme
- Monitoring bodyweight and uniformity
- Nutrition
- Biosecurity and vaccination

2.1. STOCKING DENSITY, DRINKER SPACE AND FEEDING SPACE IN REARING

	From day old to 2 weeks of age		From 2 to 5 weeks of age		From 6 weeks to transfer	
	Temperate climate	Hot climate	Temperate climate	Hot climate	Temperate climate	Hot climate
Stocking density (1) / useable area (2)	30 birds/m ²	25 birds/m ²	15 birds/m ²	12-15 birds/m ²	12-14 birds/m ²	8-10 birds/m ²
Starter drinkers	1 / 80 chicks	1 / 70 chicks	-	-	-	-
Bell drinkers	1 / 150 birds	1 / 150 birds	1 / 100 chicks	1 / 75 chicks	1 / 100 birds	1 / 75 birds
Nipple drinkers	1 / 12 birds	1 / 10 birds	1 / 12 birds	1 / 10 birds	1 / 12 birds	1 / 10 birds
Starting feed pans	1 / 50 chicks		-		-	
Linear chain feeders	2.5 cm / birds		4 cm / birds		6 cm / bird	
Pan feeders	1 / 30 birds		1 / 25 birds		1 / 25 birds	

(1) In Aviary system, stocking density doesn't depend on the age but the moment when the system is opened.

(2) Useable area includes floor, system and platforms areas.

FLOCK MANAGEMENT DURING THE REARING PERIOD

2.2. STARTINGUP STRATEGY

ALL SYSTEM

- Before chicks arrive, feed should be accessible to the chicks. Feeders should be well filled and feed should be spread over chick paper especially close to the drinking lines. This stimulates the chicks to use the drinking equipment.
- Feed must be regularly renewed to keep it fresh and attractive.
- Before arrival the drinking lines must be checked, so that fresh water is provided and leakage is prevented.
- Triggering the nipples or water cups encourages the birds to drink
- Unload the chicks close to drinkers and feeders.

FLOOR SYSTEM

- Additional starter drinkers and feeders can be used in the first 2 weeks
- If brooding takes place in only part of the house, do not exceed a stocking density of 25 to 30 chicks per available m². Thus allowing chicks to spread quickly over the whole house within the first 7 days.
- In case of use of circular brooder guards (rings or surrounds):
 - 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. Usually, guards can be removed 5 to 7 days after arrival.

AVIARY SYSTEM

- Chick paper should be placed in the chicks unloading tier (aviary multi-tier system) or on the bottom of the system. Paper should be used until at least 7-10 days of age, it's important to use a good quality paper.
- In aviary multi-tier system and in the case of coccidiosis vaccination, papers should be kept until at least 3 weeks with regards to re-contamination.

Photo: placement of chick paper on arrival



2.3. CLIMATE STRATEGY

Before and after arrival and starting up of the chicks, the below information can be used as guidelines for optimal performance. Be aware that those setting depends highly on local climate conditions and must be adapted accordingly.

❖ Before chicks arrival:

- After hatch, a chick is poikilotherm. This means that it can't fully regulate its own bodytemperature. Therefore it is important that the housing climate is supported at such a way that the thermoneutral bodytemperature of 40°C is achieved.
- Raise the house temperature at least 36 hours before chick arrival to 29°C-30°C
- Pre-heat the whole house 30 to 40 hours prior to chick arrival ensuring the floor and system is fully warmed before placement to 35°C.

FLOCK MANAGEMENT DURING THE REARING PERIOD

❖ After chicks arrival:

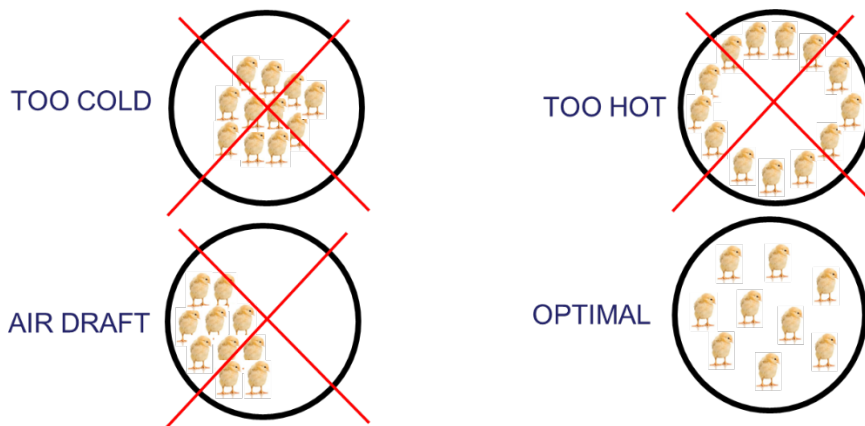
- Never overheat the chicks and give them a choice within the desired temperature range.
- Take into account the temperature at chick level.
- Depending on the brooder design, place the brooders high enough above the litter (at least 1.5 m) at an angle, to allow for uniform distribution of the chicks.
- Check the chicks body temperature after start up to adjust the house temperature by gently touching the chick cloaca with the probe of an ear thermometer. The optimal chick body temperature is 40-41 °C. It is important to measure the body temperature of a sufficient numbers of chicks distributed in different parts of the house.

Photos: Control of chicks temperature



- Check the distribution and behaviour of the chicks to enable you to adapt and manage the temperature of the House:
 - Chicks are panting and are lying on the ground with their wings spread → temperature is too high

Scheme: Chicks distribution example



FLOCK MANAGEMENT DURING THE REARING PERIOD

Table: Temperature and relative humidity recommendations

	Under the brooder	Near the circular guard	Room temperature	Relative humidity
Before arrival (2-3 days)	30 °C	30 °C	30 °C	55 – 60 %
Before arrival (1 day)	35 °C	35 °C	35 °C	55 – 60 %
Week 1	35 – 33 °C	32 – 31 °C	30 – 28 °C	55 – 60 %
Week 2	32 °C	30 – 28 °C	28 – 26 °C	55 – 60 %
Week 3	28 °C	28 – 26 °C	26 – 24 °C	55 – 60 %
Week 4			22 – 20 °C	55 – 60 %
Week 5			22 – 20 °C	60 – 65 %
Week 6			22 – 20 °C	60 – 65 %
Week 7			22 – 20 °C	60 – 70 %
Week 8			21 – 19 °C	60 – 70 %
Till transfer			20 – 18 °C	60 – 70 %

Temperature and relative humidity are important climate parameters, but not the only ones. An optimal ventilation in the rearing house is important to obtain the right oxygen level, a uniform air and temperature distribution and for the removal of dust and ammonia. If mechanical ventilation is used, the ventilation settings are calculated based on:

- The right temperature based on the age of the chicks
- Constant RH (between 50-70%). Too dry air can damage the oral epithelium.
- An O₂ level around 20%
 - CO₂ with direct heating < 5000 ppm
 - CO₂ with indirect heating < 3000 ppm
 - CO < 10 ppm
 - Ammonia < 10 ppm
 - Inspirable dust < 3,5 mg/m³

Based on those settings the recommendations for minimum ventilation results in:

- 0,7 m³ per kg housed in animal, when outside temperature colder than 10°C.
- 1,0 m³ per kg housed animal, when outside temperature warmer than 10°C.

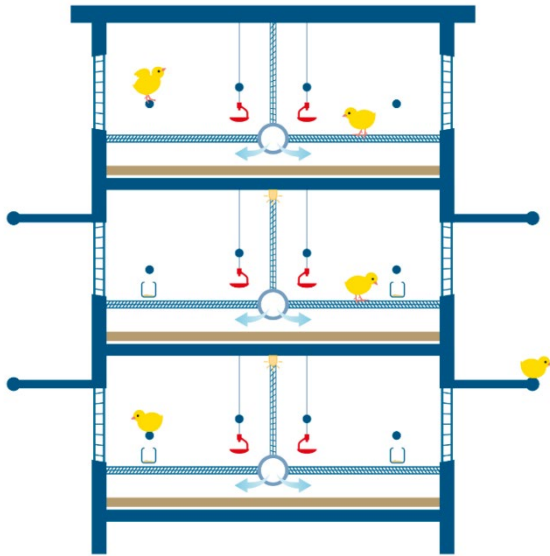
FLOCK MANAGEMENT DURING THE REARING PERIOD

2.4. SYSTEM TRAINING IN AVIARY SYSTEM

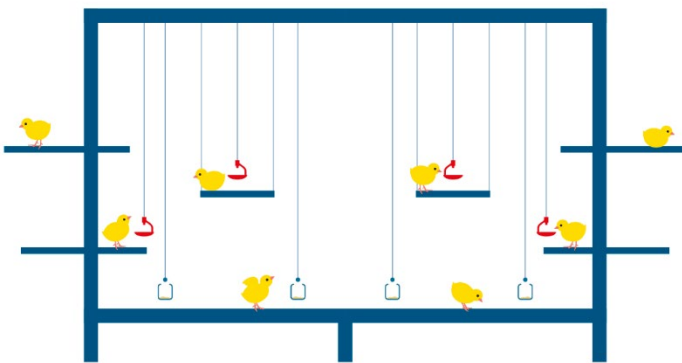
Besides obtaining a good bodyweight and uniformity, one of the main target of aviary rearing system is achieving a well trained pullet that moves actively through the house and over the system. After transfer in production house, this training enhance the access to the different levels of the system and so optimize the nesting behaviour as well as access to the water and feeding system.

Aviary rearing systems can roughly be divided in 2 categories: multi-tier (left) and platform (right). These two different systems require different management.

Schema and photo of Aviary rearing multi-tier systems



Schema and photo of Aviary rearing platform systems



FLOCK MANAGEMENT DURING THE REARING PERIOD

❖ Pullet training in aviary system

Multi-tier system	Platform system
<ul style="list-style-type: none"> Multi-tier systems can be composed of up to 4 tiers. This system can be supplied with a movable platform between the tiers. If a platform is presented, it is most of the time combined with a drinking line on top. After arrival at the farm, the chicks are usually placed in the middle or upper 2 tiers where temperature is usually slightly higher. For the farmer it provides also a better sight on the chicks. Chicks remain for approximately 4 weeks in their closed tier. After 4 weeks and if the chicks are well developed and active, system can be opened. If a movable platform is used, it will be placed at a low level so that the chicks can use it as a stair to access the opened level. Most of the time a perche is also present in front side of the cage. This will also help the chicks to jump out or in the cages. From week 4 to 8, the movable platform can be adjusted to the behaviour of the pullets. If the condition and development of the pullets is in the standard, the platform should be progressively lifted up to stimulate the jumping behaviour of the hens. Farmer must check the system behaviour of the pullets when the light is off. All of them should be back and stay overnight in the system. Pullets remaining on floor during the night will have higher risk of laying on the floor once in the production house. 	<ul style="list-style-type: none"> The chicks are always starting up in the system on chick paper, with all the platforms down. A water line can be installed above the movable platforms and an extra feeding chain on the upper fixed platform level. From the first week onwards the movable platforms will be progressively lifted so that the chicks have to jump to get to the drinking system. Chicks remain for approximately 4 weeks in the system. Thereafter some side platforms are opened so that the chicks have access to the litter space on the ground floor. It is possible to use stairs to stimulate the young chicks to come back from the litter space on the system. Together with opening of the system, some side platforms are placed at an angle. This stimulates the chicks at the same time to move upwards to the second fixed platform level. In the weeks that follow (approx. 6 – 10) the adjustment of the movable platforms and the extra feeding chain at the second fixed platform level should stimulate the hens to move over the complete system. Farmer must check the system behaviour of the pullets when the light is off. All of them should be back and stay overnight in the system. Pullets remaining on floor during the night will have higher risk of laying on the floor once in the production house.

Furhermore, there are other tools to stimulate the system training of the hens, which are **block feeding, water training and light training**.

FLOCK MANAGEMENT DURING THE REARING PERIOD

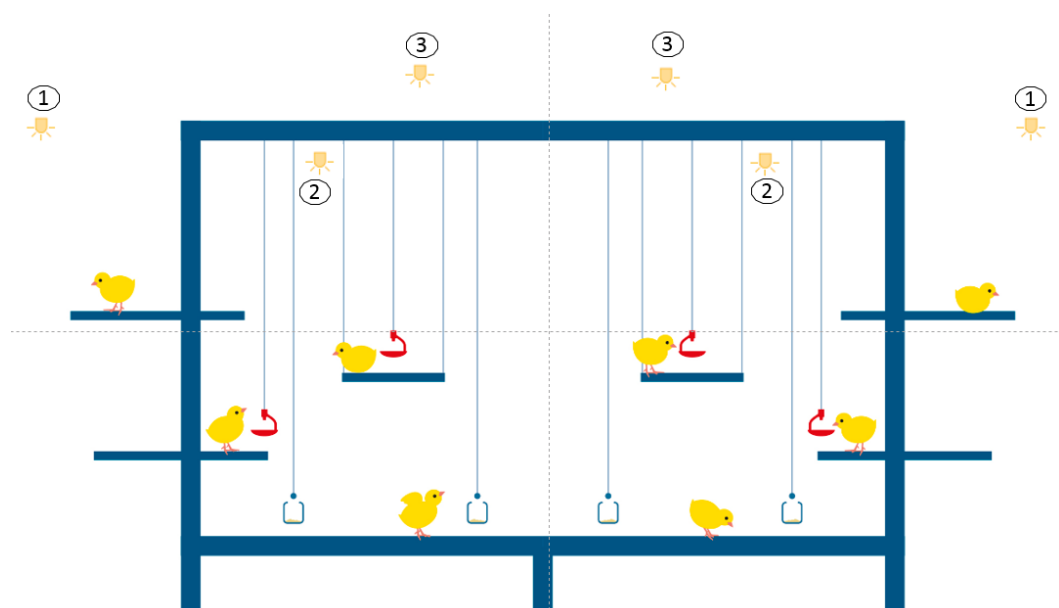
2.5. LIGHT TRAINING STRATEGY

A specific dimming procedure can be used to stimulate the pullets to move up from the litter area to the system before night time. Herebelow is an example of procedure:

- Step 1: Turn-off the outside lights above the litter space 15 minutes before the total light is switched off. Since pullets are attracted by light, they will move from the litter space towards the system. When the pullets are young (4 to 6 weeks of age) and just released from the system, the farmer should, in addition, daily stimulate the pullets physically at the same time by walking around the system. When it is done from a young age, the switch-off of the outside lights will work as a Pavlov effect on the long term. Birds will get used to the signal and will start to come back in the system.
- Step 2: Switch off the light inside the rearing system 5 minutes before the total house is dark. This is only possible when there is a 'third' lighting level above the system.
- Step 3: This third light level can be dimmed as final step. It will stimulate the pullets to move more upwards in the system.

The total dimming time should be as short as possible. Start with a maximum of 15 minutes and adapt it to the behaviour of the birds. If the procedure is too long, there is a risk that pullets move back from the system towards the litter space.

Figure: 3 steps light dimming procedure in rearing



2.6. FEEDING TRAINING STRATEGY

During the three first weeks, chicks shall have a permanent access to the feed in order to favour the start. Afterwards, it is recommended to progressively implement empty feeders once per day in the middle of the day or afternoon. The last feed distribution shall occur 1 hour before light switch off by filling the chain at 100%. The benefits of this strategy are:

- Preventing selective feed intake and thereby stimulating growth, development and uniformity
- Triggering the pullets to come in the system before light switch off.

FLOCK MANAGEMENT DURING THE REARING PERIOD

2.7. WATER TRAINING STRATEGY

Water training is another tool that can be used to stimulate the pullets to move through the system. Water training should only be started when the growth and development of the hens is in the standard. If all parameters are on standard, it can be started at approximately 8 weeks of age.

The principal of water training is to shut down a drinking line on one level, so that the hens have to move to another level for drinking. Based on the vaccination scheme, behaviour and condition of the hens the training can be extended at a flexible way.

This practice requires to closely observe birds behavior as well as daily follow up the water consumption to make sure it remains constant.

Water training can only be used in an aviary multi-tier system. In an aviary platform system there is always water training due to the fact that the hens have to jump on the plateau to reach the water.

2.8. GRIT AND GRAIN

To maintain an active feeding behaviour and to help the development of the digestive tract and encourage the birds to scratch the litter, it is advised to give grit and grain to the birds from 4 to 5 weeks of age:

- Grit (insoluble stone particles of 2 to 4 mm): 1 to 3 g per week per bird, distributed over 2 or 3 days.
- Grain (broken maize, wheat): 3 g per bird every day, or every other day

LIGHTING PROGRAMME

3. LIGHTING PROGRAMME

3.1. GENERAL RULES

Sexual maturity and production are largely influenced by the changes in day length to which pullets are exposed. Carefully chosen lighting programmes will help to optimise the performance of commercial layers. Remember that sexual maturity and bodyweight at sexual maturity influence egg production, egg size, liveability, and egg shell quality. It is difficult to advise a universally optimum and perfect lighting programme. The following lighting programmes are examples and have to be considered as a guideline to help formulate a lighting programme adapted to your own situation.

To establish your own lighting programme, it is important to take into account the following factors:

- Your location (changes in light duration (day length) during the year)
- The characteristics of the rearing unit (light-controlled, semi-dark or open house type)
- Season of the year (increasing or decreasing day length)
- Temperature (light duration at the highest temperature)
- Date of the hatch (what is the natural day length at the bodyweight targeted when light stimulation will take place for onset of lay?)
- Growth of the flock
- Past records of performance obtained in this rearing unit
- Avoid any unwanted external lights in the dark house. It can affect the lighting program and efficiency and induce feather pecking.

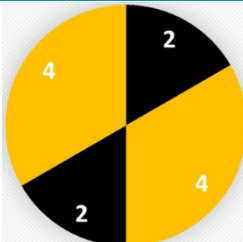

❖ LIGHTING PROGRAMME DURING THE FIRST WEEKS OF THE REARING PERIOD

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

The decrease in artificial light duration during the day is then adjusted according to the housing type. For an open house system (and above 20° Latitude), determine the natural light day length that the birds will encounter before 16 weeks of age. This will then help determine the maximum day length the flock will be given and help avoid an unwanted early light stimulation before the flock has matured sufficiently. Early light stimulation will be promoted by a natural increase in day length during rearing.

In dark rearing houses (and when allowed by the local regulation), it is possible to use an intermittent lighting programme during the first two weeks of age. It allows synchronisation of the chicks' behaviour for; eating, drinking and resting. It can have a beneficial effect on the weakest chicks which are stimulated by the stronger ones and improves the flock uniformity. After two weeks, switch to a regular step down lighting programme.

Table: Intermittent lighting programme

WEEK 1	WEEK 2
<ul style="list-style-type: none"> • 4 hours light • 2 hours darkness • 4 hours light • 2 hours darkness 	<ul style="list-style-type: none"> • 8 hours light • 2 hours darkness • 8 hours light • 6 hours darkness 

LIGHTING PROGRAMME

❖ LIGHTING PROGRAMME FROM 8 WEEKS OF AGE TO TARGETED AGE OF LIGHT STIMULATION.

In order to control sexual maturity and to avoid early sexual maturity at an inadequate and immature bodyweight, it is important to avoid every day any increase in light duration (due to a natural increase in day length) during this period.

According to the season in a dark house system a stable day length can be used between 7 weeks of age and the age when light stimulation is targeted. The light duration during this period can also be adapted according to the growth of the pullets (10, 11 or 12 hours could be used when growth is slow).

In an open house system, the most difficult system for controlling sexual maturity, the natural day length at which the pullets will be exposed to at 16 weeks of age will determine the light duration at the platform to avoid any increase of light duration before 16 weeks of age.

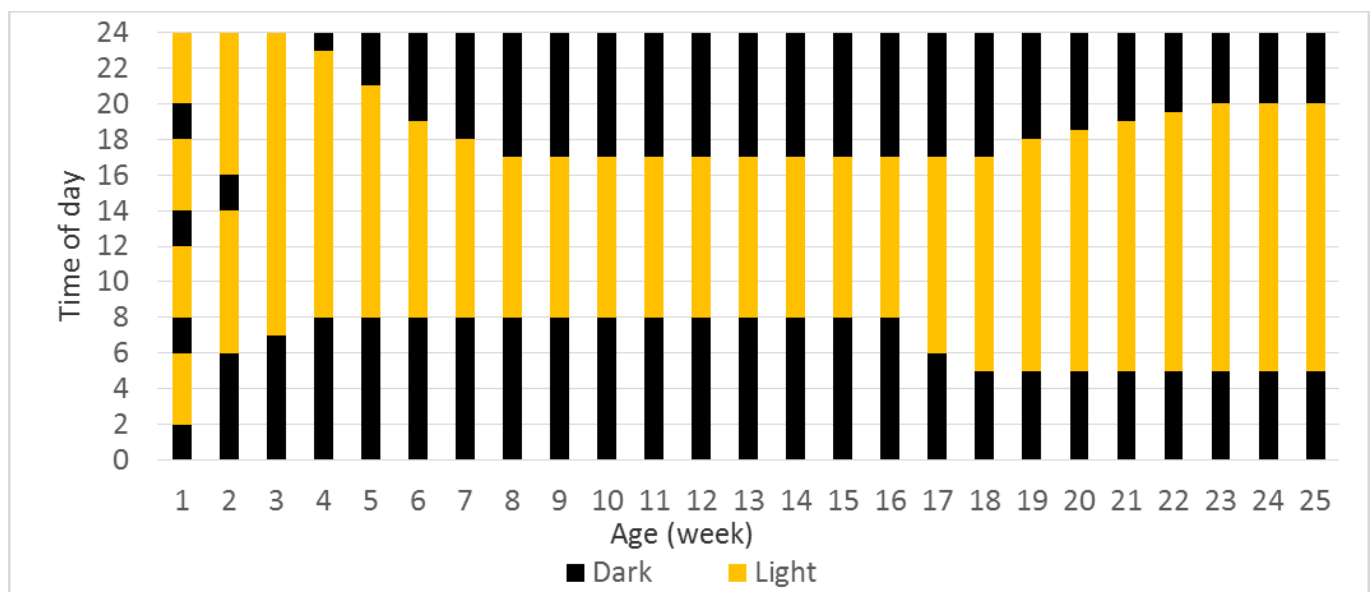
❖ INCREASING DAY LENGTH TO STIMULATE EGG PRODUCTION

For all conditions, the main indicator to determine the time of light stimulation is the bodyweight.

❖ LIGHTING PROGRAMME DURING PRODUCTION

Never decrease the artificial light duration during the production period as this can lead to an early decline in egg production.

Graph: Example of lighting programme in light controlled rearing and laying houses



❖ 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 and the laying house).

LIGHTING PROGRAMME

3.2. VARIOUS HOUSING AND LIGHTING SITUATIONS TO CONSIDER – EXAMPLE PROGRAMMES

❖ Light-controlled rearing house to light-controlled laying house:

- Use a slow step down lighting programme until 6 weeks of age.
- A constant 9 hours day length from 7 weeks to light stimulation (12 hours may be used where needed according to growth)
- Increase the light duration by 2 hours when body weight is between 1,110-1,170 g,
- Add 1 hour and/or 30 minutes per week until 15.30 hours or 16 hours total light duration is obtained.

❖ Light-controlled rearing house to open or semi-dark laying house:

- Use a slow step down lighting programme until 6 weeks of age.
- A constant 9-10 hours day length from 7 to 15 weeks of age.
- Increase light duration by 2 hours when body weight is between 1,110-1,170 g.
- Add 1 hour and/or 30 minutes per week until 15.30 hours or 16 hours total light is obtained.
- Light intensity in rearing should be managed to avoid any dramatic and sudden increase in light intensity at transfer time.

❖ Open or semi-dark rearing house to light-controlled laying house:

- Use a slow step down lighting programme until 6 weeks of age.
- A constant 9-10 hours (or natural day length) from 7 to 15 weeks of age.
- Increase light duration by 2 hours at 1,110-1,170 g of bodyweight when there is a decreasing day length.
- Increase light duration by 1 hour at 1,110-1,170 g of bodyweight when there is an increasing day length.
- Add 1 hour and/or 30 minutes per week until 15.30 hours or 16 hours total light is obtained.
- Light intensity from transfer time should be managed to avoid any dramatic and sudden decrease of light intensity.

❖ Open or semi-dark rearing house to open or semi-dark laying house:

- Use a slow step down lighting programme until 6 weeks of age.
- A constant 9-10 hours (or NDL) day length from 7 to 15 weeks of age.
- Increase light duration by 2 hours at 1,110-1,170 g of bodyweight when there is a decreasing day length.
- Increase light duration by 1 hour at 1,110-1,170 g of bodyweight when there is an increasing day length.
- Make light stimulation more effective by adding the additional hours of light in the morning instead of the evening.
- Add 1 hour and/or 30 minutes per week until 15.30 hours or 16 hours total light is obtained.

LIGHTING PROGRAMME

❖ In a hot climate:

- Use a slow step down lighting programme until 12 weeks of age.
- A constant natural day length from 12 weeks of age to 2-5% of production.
- Increase light duration by 1 hour and/or 30 minutes from 2-5% of production in the morning.
- Add 1 hour and/or 30 minutes per week until 15.30 hours or 16 hours total light is obtained.
- The light on should be adapted to allow the birds to eat during the cooler part of the day.

Flash Feeding:

When allowed by the local regulation, it is possible to use an additional 1.00 to 1.30 hours of light with feed usually 3 hours after the lights going out, to ensure the longest period of dark remains after the lights go back out 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.

Please contact the NOVOGEN technician in your area for more specific advice.

LIGHTING PROGRAMME**3.3. LIGHTING PROGRAMME IN LIGHT-CONTROLLED REARING HOUSES (<0.5 LUX)**

Age (weeks)	Age (days)	Bodyweight at start of the week (g)	Average laying rate of the week	Light duration in hours	Light intensity
0	0 to 2			22.00 (1)	20-40 lux
1	3 to 7			20.00 (1)	20-30 lux
2	8 to 14			19.00	10-20 lux
3	15 to 21			17.00	5-10 lux
4	21 to 28			15.00	5-10 lux
5	29 to 35			13.00	5-10 lux
6	36 to 42			11.00	5-10 lux
7	43 to 49			10.00	5-10 lux
8	50 to 56			09.00	5-10 lux
9	57 to 63			09.00	5-10 lux
10	64 to 70			09.00	5-10 lux
11	71 to 77			09.00	5-10 lux
12	78 to 84			09.00	5-10 lux
13	85 to 91			09.00	5-10 lux
14	92 to 98			09.00	5-10 lux
15	99 to 105			09.00	5-10 lux
16	106 to 112	(4)		09.00 (4)	5-10 lux
17	113 to 119	1,110-1,170		11.00	5-15 lux
18	120 to 126	1,170-1,235	0-1%	12.00	5-15 lux
19	127 to 133	1,230-1,300	0-10%	13.00 (2)	5-15 lux
20	134 to 140	1,290-1,370	10-30%	13.30	5-15 lux
21	141 to 147	1,335-1,425	35-60%	14.00	5-15 lux
22	148 to 154	1,375-1,470	60-85%	14.30	5-15 lux
23	155 to 161	1,420-1,510	80-90%	15.30	5-15 lux
24	162 to 168	1,455-1,550	85-92%	15.30 (3)	5-15 lux
25	169 to 175	1,485-1,580	90-95%	15.30 (3)	5-15 lux
25 +	176 to 182	1,510-1,610		15.30 (3)	5-15 lux

(1) - An intermittent lighting programme can be implemented (if allowed by the local regulation)

(2) - From 19 weeks of age, flash feeding could be added (if allowed by the local regulation)

(3) - Could be increased to 16 hours according to feed consumption

(4) - According to the average egg weight requested by the market, it could be possible to light stimulate the pullets one week earlier

(5) – Light intensity and light stimulation should be adapted to local environment and flock condition.

LIGHTING PROGRAMME**3.4. LIGHTING PROGRAMME IN SEMI – DARK OR OPEN REARING HOUSES (>0.5 LUX)**

Age (week)	Age (days)	Bodyweight at start of the week (g)	Average laying rate of the week	In decreasing day length in hours	In increasing day length in hours
0	0 to 2			22.00	22.00
1	3 to 7			20.00	20.00
2	8 to 14			19.00	19.00
3	15 to 21			17.00	17.00
4	21 to 28			15.00	15.00
5	29 to 35			13.00 (or DLN)	13.00 (or DLN)
6	36 to 42			12.00 (or DLN)	12.00 (or DLN)
7	43 to 49			10.00 (or DLN)	10.00 (or DLN)
8	50 to 56			10.00 (or DLN)	10.00 (or DLN)
9	57 to 63			10.00 (or DLN)	10.00 (or DLN)
10	64 to 70			10.00 (or DLN)	10.00 (or DLN)
11	71 to 77			10.00 (or DLN)	10.00 (or DLN)
12	78 to 84			10.00 (or DLN)	10.00 (or DLN)
13	85 to 91			10.00 (or DLN)	10.00 (or DLN)
14	92 to 98			10.00 (or DLN)	10.00 (or DLN)
15	99 to 105			10.00 (or DLN)	10.00 (or DLN)
16	106 to 112			10.00 (or DLN)	10.00 (or DLN)
17	113 to 119	1,110-1,170		+2.00 (or 16.00)	+1.00 (or 16.00)
18	120 to 126	1,170-1,235	0-1%	+1.00 (or 16.00)	+1.00 (or 16.00)
19	127 to 133	1,230-1,300	0-10%	+1.00 (or 16.00) (1)	+1.00 (or 16.00)
20	134 to 140	1,290-1,370	10-30%	+0.30 (or 16.00)	+1.00 (or 16.00)
21	141 to 147	1,335-1,425	35-60%	+0.30 (or 16.00)	+0.30 (or 16.00)
22	148 to 154	1,375-1,470	60-85%	+0.30 (or 16.00)	+0.30 (or 16.00)
23	155 to 161	1,420-1,510	80-90%	+0.30 (or 16.00)	+0.30 (or 16.00)
24	162 to 168	1,455-1,550	85-92%	16.00	+0.30 (or 16.00)
25	169 to 175	1,485-1,580	90-95%	16.00	16.00
25+	176 to 182	1,510-1,610			

NDL: Natural Day Length

(1) - From 19 weeks of age, flash feeding could be added

LIGHTING PROGRAMME**3.5. LIGHTING PROGRAMME IN HOT CLIMATE (BETWEEN 20° NORTH AND 20° SOUTH)**

Age (week)	Age (days)	Bodyweight at start of the week (g)	Average laying rate of the week	Light duration in hours
0	0 to 2			22.00
1	3 to 7			20.00
2	8 to 14			19.00
3	15 to 21			18.00
4	21 to 28			17.00
5	29 to 35			16.00
6	36 to 42			15.30
7	43 to 49			15.00
8	50 to 56			14.30
9	57 to 63			14.00
10	64 to 70			13.30
11	71 to 77			13.00
12	78 to 84			12.30
13	85 to 91			12.00
14	92 to 98			12.00 (or NDL)
15	99 to 105			12.00 (or NDL)
16	106 to 112			12.00 (or NDL)
17	113 to 119	1,110-1,170		12.00 (or NDL)
18	120 to 126	1,170-1,235	0-1%	12.00 (or NDL)
19	127 to 133	1,230-1,300	0-10%	+ 1.00 (1)
20	134 to 140	1,290-1,370	10-30%	+1.00
21	141 to 147	1,335-1,425	35-60%	+ 1.00
22	148 to 154	1,375-1,470	60-85%	+ 0.30
23	155 to 161	1,420-1,510	80-90%	+0.30 (or 16.00)
24	162 to 168	1,455-1,550	85-92%	16.00
25	169 to 175	1,485-1,580	90-95%	16.00
25+	176 to 182	1,510-1,610		

NDL: Natural Day Length

(1) - From 19 weeks of age, flash feeding could be added (if allowed by the local regulation)

FLOCK MANAGEMENT DURING THE PRODUCTION PERIOD

4. FLOCK MANAGEMENT DURING THE PRODUCTION PERIOD

4.1. STOCKING DENSITY, DRINKER SPACE AND FEEDING SPACE IN PRODUCTION

	Temperate climate	Hot climate
Stocking density / useable area (1)	8-9 birds/m ²	5-6 birds/m ²
Bell drinkers	1 cm / bird	1,5 cm / bird
Nipple drinkers	1 / 10 birds	1 / 8 birds
Linear chain feeders	10 cm / bird	
Pan feeders	1 / 20 birds	
Perches	15 cm / bird (> 30 cm between perches and > 20 cm between wall and perch)	
Pop Holes	2m / 1000 birds (high > 35cm / width > 40 cm)	
Nest	Individual nest = 1 nest / 7 birds Group nest = 1m ² / 120 birds	
Litter area	> 250 cm ² / bird	

(1) Useable area includes floor, system and platforms areas. Nests area is not included.

4.2. 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 on a similar drinking system as they will encounter on transfer.
- Increase light intensity to encourage water consumption
- Maintain temperature as close as possible to the temperature experienced by the pullets at the end of the rearing period.

4.3. LIGHTING PROGRAMME DURING THE PRODUCTION PERIOD

The light duration after transfer should be adjusted to match the light duration experienced at the end of the rearing period. The post transfer light duration should be at least the same length as during the rearing phase. It may be longer according to the plan for light stimulation.

As the birds remain sensitive to changes in light duration, never decrease the day length during the entire production period.

FLOCK MANAGEMENT DURING THE PRODUCTION PERIOD

4.4. LIGHT INTENSITY MANAGEMENT DURING THE PRODUCTION PERIOD

It is possible after the peak of lay to reduce progressively the artificial light intensity. This may limit feed wastage, excessive activity of the birds and reduce the risk of mortality. Please take into account that light intensity should remain well distributed all over the house.

4.5. LIGHT TRAINING STRATEGY

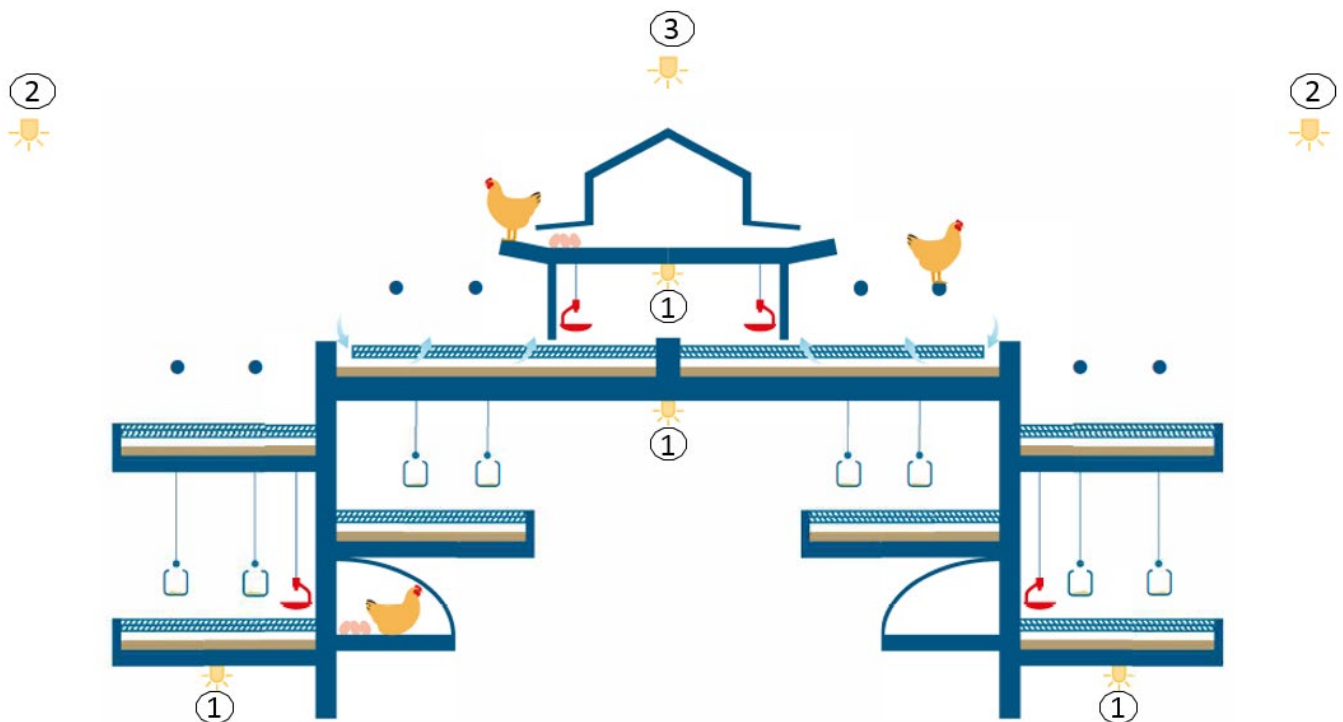
In production several systems and lighting equipment are used. In all cases, target is to progressively switch off the light in the system and house to ensure birds move up to the perches areas.

Herbelow is an example of lighting strategy based on 3 lighting steps:

- Step 1: Switch off the light inside the system. At this way the hens are stimulated to move from under the system to the outside or above.
- Step 2: Switch off the side light outside the system
- Step 3: The central light on top of the system can be dimmed a few minutes later.

Total procedure should take approximately 15 minutes, timing must be adapted according to birds behaviour.

Figure: Example of 3 steps light dimming procedures in production



FLOCK MANAGEMENT DURING THE PRODUCTION PERIOD

4.6. FLOOR EGGS PREVENTION

Floor eggs is a multifactorial problem often related to management issue at the onset of lay or house and equipment design. We have indicated herebelow some important recommendations to maintain a good nesting behaviour:

- 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.
- Hens should not be disturbed while laying: avoid flock inspection and feed distribution during the main laying period
- Nest:
 - Sufficient numbers
 - Easy access
 - Comfortable floor: use material such as Astro Turf, rubber floor, litter...
 - Uniform repartition within the house
 - Entrance of the nest should be well lighted and the inside of the nest darker
 - No draught in the nest area
 - Possibility to use a light nest to switch on 1 hour before the house light switch on. It enables the birds which are laying earlier to find the nest.
- Lighting: ensure a uniform and sufficient light in the whole house. Any darker area is favourable to a floor laying behaviour.
- Birds should sleep on top of the system and not on the litter
- Litter: depth at the onset of lay should not exceed 2-3 cm
- Fence: when allowed by local regulation, 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.
- Drinking and feeding systems in floor system:
 - It should not be located more than 2-3 meters of the nest
 - Feeding system should be located as high or low as possible (according to the system), to allow an easy circulation of the hens. Chain feeders can be directly fixed on the slats.
- Specific case of Floor-Slats system:
 - Strictly respect the proportion of 2/3 slats and 1/3 floor
 - Possibility to use ladders to facilitate access to the slats
 - Install the drinking and feeding system in the slats area
 - After transfer, possibility to block the hens in the slats area for a maximum of 3 to 5 days. In this situation, be careful to the nest access.

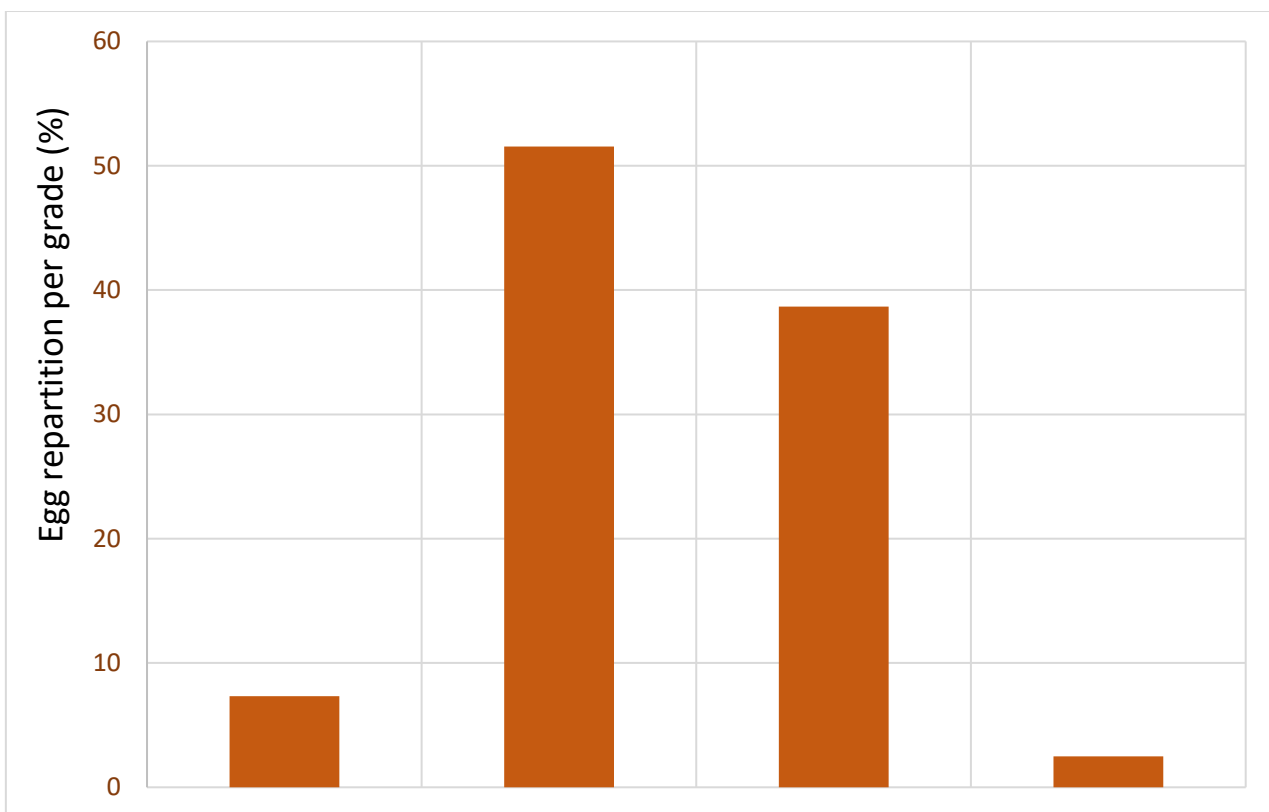
FLOCK MANAGEMENT DURING THE PRODUCTION PERIOD

4.7. MANAGEMENT OF EGG WEIGHT

The egg weight profile of a flock is mainly determined by the following factors:

- Bodyweight at light stimulation (or at sexual maturity).
 - The higher the bodyweight at sexual maturity the higher will be the egg weight during the laying period.
 - The lower the bodyweight at sexual maturity the lower will be the egg weight during the laying period.
 - Delay the onset of the egg production to increase average egg weight during the production period.
 - Plan for an earlier sexual maturity to decrease average egg weight during the production period.
- Evolution of the bodyweight during the first week of production
- Nutrition also has important effects on the evolution of the egg weight during production:
 - Intake of protein or digestible amino acids
 - Metabolisable energy of the feed
 - Linoleic acid and oil content of the feed

Graph: Cumulative NOVOgen WHITE Light egg distribution at 90 weeks according to EU egg weight classification



S	M	L	XL
small	medium	large	very large
<53 g	53-63 g	63-73 g	>73 g

FLOCK MANAGEMENT DURING THE PRODUCTION PERIOD

4.8. MANAGEMENT OF EGG SHELL QUALITY

Egg shell quality has become even more critical due to the lengthening of production cycles and the development of automatic egg collection systems. While substantial genetic progress has been achieved, diet and feeding techniques are key to the expression of this genetic progress.

- Egg shell quality and colour depend essentially on the hen's ability to use its dietary calcium during shell formation i.e. shortly before night time until oviposition. A good calcium diet during the production period improves egg shell quality and colour and prevents bone demineralization (osteoporosis) and fractures. The quality of the calcium in the diet is determined by the calcium presentation, i.e. particle and / or powder form within the ration and its content in the feed. It is particularly important to increase the calcium content after 45 weeks to satisfy the increase of calcium requirement due to bigger egg size and to compensate for the natural shell quality decreasing with the age.
- Oyster shell is a good ingredient to improve the egg shell quality. The particle size and solubility are usually very good for laying hens it is possible to add 1g per bird at the end of the afternoon to promote a better calcium intake for supplying the egg shell deposition during the night. Take care of the quality about bacteriological level & calcium solubility to be sure to use a safe product.
- The feed distribution has also important effect on the shell quality. When possible, hens ingest more than 50% of their ration during the 6 hours prior to lights out in order to satisfy their specific calcium appetite. A fraction of this calcium intake is stored in the gizzard. Since hens do not eat during the night (calcification period), shell quality depends on the quantity of calcium remaining in the digestive tract at the end of the day. Another way to improve shell quality is to encourage hens to consume calcium in the middle of the night with the use of a flash feed when it is allowed. Please seek the advice of your local NOVOGEN technician.
- More information on the relation between feed and egg shell quality can be found in the NOVOGEN nutrition guide.

Table: Egg shell quality references per age

Eggshell quality (Newton)	30 - 40 weeks	40 - 50 weeks	50 - 60 weeks	60 – 70+ weeks
Good	> 41	> 40	> 39	> 38
Moderate	39	38	37	36
Poor	< 38	< 37	< 36	< 35

Photo: Shell strength measure



MONITORING BODYWEIGHT AND UNIFORMITY

5. MONITORING BODYWEIGHT AND UNIFORMITY

The main objective is to reach the appropriate bodyweight and uniformity targets at different stages of the bird's development:

- At the early stage (0 – 7 weeks: period of frame development)
- At sexual maturity with an even growth curve (a low bodyweight at sexual maturity could affect later performances)
- At the start of lay to the peak of production (a growth of at least 300g from 5% of lay until 30 weeks means that the bird's needs for egg production and growth are covered)

5.1. 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 of age, weigh the birds every 2 weeks and then monthly from 35 weeks of age,
- 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. It is good practice to walk the house first to stir the birds up to allow for a more realistic sample to be penned.
- After weighing, average body weight and uniformity are calculated and immediately plotted on NOVOGEN 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 the uniformity.

5.2. UNIFORMITY CONTROL

- The uniformity target is set to ensure 80 % of the body weights are in a range between + 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 treatment
 - temperature and ventilation

6. BEAK TREATMENT

6.1. BEAK TREATMENT MONITORING

- Beak treatment is sometimes undertaken where either light intensity cannot be controlled due to the design of the house or when other kind of challenges chronically stress out the birds. The beak treatment procedure is performed to prevent feather pecking and cannibalism under these conditions.
- Beak treatment is a delicate operation and should only be carried-out by well-trained and experienced operators. Poor beak treatment can affect the ability of the birds to eat and drink correctly and leads to unevenness. Attention should be paid to local regulations regarding beak treatment and it is advisable to seek veterinary advice to ensure the procedures are being correctly applied.
- Two different methods can be used for beak treatment. The first one consists of an infrared treatment of the beak at day-old in the hatchery by using a specific machine. The second method can be practiced at 7-10 days by using a hot blade. With this second method and under some specific conditions, where permitted, a second beak treatment may be undertaken at 8-10 weeks.
- Before beak treatment with hot blades (in countries where this is permitted):
 - check that the birds are healthy
 - do not treat the beaks when the birds are reacting to vaccinations
 - add vitamin K to the drinking water (to prevent haemorrhaging)
 - check that the temperature of the blades is high enough to prevent haemorrhaging, but not too high which may risk chicks being burned.
- To limit the effect of beak treatment with hot blades 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 the technical recommendations, any local code or regulation concerning animal welfare should be respected.

Photo: Infra-red beak treatment machine



Photo: Pullet with a treated beak



6.2. FULLY BEAKED FLOCKS MANAGEMENT

Photo: Fully beaked pullet



In case of fully beaked flocks, different measures are necessary to prevent the consequences on selective feed intake and potential damage due to pecking:

- Strictly respect the feeding and drinking spaces and the stocking density standards before starting up. It will ensure a good uniformity of the flock and avoid risks of competition and fights between the birds.
- Keep the birds calm by avoiding any stress: equipment malfunction, visitors, any sudden changes in the management (light intensity, number of feed distributions, feed formulation...).
- Provide distractions for the birds to keep them busy: wood shaving pack, oyster shell, plastic strings... All the toys could help to maintain a good behavior. But layers get used to the toys very quickly, they need to be changed regularly, each week for example, otherwise, they stop playing with.
- Distribution of grit and grain on the floor can also enhance litter scratching.
- There is a strong relationship between feeding time and pecking, the shorter the feeding time the higher the risk of pecking. Also, the feed presentation is of high importance. If the particles are too big, it will reduce the feeding time and increase the risk of feather pecking and feed selection. If they are too fine it will induce poor appetite.
- Be on the alert for the absence of fluff or small feathers on the floor. It can mean that the birds are eating the feathers due to a nutrient deficiency in fibre source and it can easily turn into feather pecking. It can be confirmed by the presence of feather in the intestine. It is sometimes possible to reduce the level of feather pecking by increasing the fibre content of the feed, particularly insoluble fibres. It is also possible to add alfalfa or straw on the floor to provide additional fibre for the bird.
- Feed has to be well balanced in energy, amino acid, nutrient, fibre... Any deficiency in the feed can induce feather pecking.
- Placing some gas concrete blocks in the house as they can help to smoothen the sharp end of the beak and thereby prevent pecking and selective feed intake.
- It is important to maintain a suitable climate (ventilation, temperature). Hens that feel uncomfortable are inclined to start feather pecking.
- Special attention has to be given to the lighting. Light intensity and duration are important for preventing pecking. It is sometimes possible to reduce pecking by dimming or colouring the lights. In dark house, it is important to avoid any unwanted light source from outside during the night period.
- In production, it is recommended to dim the light a few days after the adaptation in the production house and to keep the nest in a dark area.
- Respect the health program and avoid parasitic proliferation.

WATER MANAGEMENT

7. WATER MANAGEMENT

Water is the first and most important requirement for poultry, it drinks around 1.8 times more than it eats. Therefore, water management and quality is a priority to ensure optimal flock performances.

7.1. WATER MANAGEMENT DURING THE REARING PERIOD

Table: Water management recommendations

Period	Advice
Before start up	<ul style="list-style-type: none"> Check the quality of the drinking water and the pipelines. Clean and rinse the water pipelines. Make sure that the water temperature is around 20 to 25°C. Check the nipples.
After start up	<ul style="list-style-type: none"> Provide unlimited water. Keep the water pressure as low as possible. It will help the chicks to find the water Adjust the height of the drinkers according to the chick size and growth. The chicks must be able to drink without difficulties.

7.2. WATER QUANTITY

The ratio water/feed is generally mentioned as being close to 2.0, but in reality it depends more on the environmental temperature. In a hot temperature climate, this ratio increases as the birds will drink more and eat less. In this condition, it is recommended to supply cool water to the birds. Water temperature above 20 °C should be avoided.

Water consumption is an important indicator to follow. Therefore, it is recommended to install a water meter on the water line. This equipment is inexpensive and easy to install. A low consumption can indicate a shortage of water supply or a sanitary problem on the flock. Waste of water can also be detected thanks to the water meter.

The below table gives some indication on water consumption according to the environmental temperature (source: ITAVI, 2012).

Table: Water consumption recommendations according to environmental temperature

House T °C	Water/Feed ratio		Water consumption in production (ml/bird)
	Rearing	Production	
15	1.6	1.7	210
20	1.7	1.8	205
25	2.3	2.1	230
30	3.0	3.1	320

7.3. WATER QUALITY

- A water sample for analysis should be taken at the entry point of the house to check the quality of the water supply, and at the end of the system to check the efficiency of the disinfection system.
- Sample once or twice a year. More samplings should be performed especially when using a local water supply (surface well, deep well, etc...)
- Clean the pipe system during the sanitary break between flocks.

Clean drinkers on a regular basis

WATER MANAGEMENT

Table: Water quality measures interpretation (ITAVI, 2007)

	Criteria		Risk
Physicochemical recommendations	pH (5.5 < pH < 6.5)	pH > 8	Antibiotic and vaccine loss of efficiency Reduction of chlorine treatment efficiency Favours the growth of detrimental Gram negative bacteria (<i>Salmonella</i> , <i>E. coli</i> , etc...)
		pH < 4	Urinary and/or digestive problems Skeletal weakening Water system corrosion
	Hardness (10 to 15°F)	> 20°F	Reduces solubility of some antibiotics and vitamins Tartar development in the water system, but poultry is quite tolerant to high hardness
		< 6°F	Trace minerals deficiency and influence on egg shell strength Water system corrosion
	Iron (≤ 0.2 mg/l) Manganese (≤ 0.05 mg/l)	Iron > 1 mg/l and/or Manganese > 0.15 mg/l	Decrease in water intake Reduction in chlorine treatment efficiency Increases bacterial development
	Nitrates (≤ 50 mg/l)	> 50 mg/l	Digestive troubles at high concentration Reduces vaccine efficiency
	Organic matter (≤ 2 mg/l)	> 5 mg/l	Look for source of contamination (water supply, biofilm)
	Nitrites (≤ 0.1 mg/l)	> 0.1 mg/l	Enhances biofilm development Can be toxic at low concentration
Bacteriological recommendations	Total flora (≤ 100 germs/ml)	> 100 germs/ml	Faecal germs contamination can be detrimental in itself as a direct source of pathogenic agents (ex: <i>E. coli</i>), but also serve as an indicator for other contaminants (like parasites or viruses)
	Salmonella (0 germs/ml)	> 0 germs/ml	
	E. Coli (0 germs/ml)	> 0 germs/ml	

Before starting any water treatment, it is recommended to take advice from a local specialist.

WATER MANAGEMENT

Table: Main physicochemical treatments

	pH	Hardness		Iron / Manganese
Treatment	Mineral acidification: chloride or sulphuric acid Organic acidification: formic, propionic, lactic... acid	Neutralization (water < 10°F)	Softening (water > 15°F)	Iron / Manganese removal
Effect	pH reduction Small dose can be enough Bacteriostatic or bactericidal action depending on the acid used Potentially positive effect on digestive system (not for the mineral acids)	Increase of pH and hardness	Hardness reduction	Iron / Manganese removal

Table: Main antibacterial treatments

	Chlorine	Chlorine dioxide	Hydrogen peroxide
Principle of action	Mixed in the water Free residual chlorine (FRC) is reacting with bacteria and has to be measured at the end of the water line.	Soluble gas made from the mix of sodium chlorite and chlorehydric acid. The gas is injected in the water.	Mixed in the water Recommended to be used with paracetic acid for the pipes cleaning during the flock (intermittent treatment)
Methods	Initial dosage of 1 to 4 mg/l of active chlorine 0.3 to 0.6 mg/l of free chlorine at the end of the pipe line. To check every 2 weeks with a DPD coloured system. For a better efficiency, avoid high level of iron, manganese and organic matter and a pH > 7.5.	Maximum initial dosage of 1 mg/l 0.3 to 0.5 mg/l of FRC at the end of the pipe line. To check every 2 weeks (reactant DPD). For a better efficiency, avoid high level of iron, manganese and organic matter. No effect of the pH on the treatment	Initial dosage depends on the product concentration 30 to 50 mg/l of hydrogen peroxide at the end of the water line. For a better efficiency, avoid the presence of organic matter. No effect of the pH on the treatment
Installation and running cost	--	++	++
Monitoring the efficiency	At the end of the water line with a colorimetric test: reactantDPD	With a colorimetric test: reactant DPD (level of chlorine dioxide = 1.9 free chlorine)	Level of hydrogen peroxide to be measured with reactive strips.
Efficient against...	Bacteria (at a concentration of 0.2 mg/l at the end of the water line), fungi, algae and virus.	Bacteria, fungi, algae, virus and spores.	Bacteria, fungi, algae, virus and spores.
Other existing water disinfection systems: electrolysis, UV sterilization, Copper sulphate...			

8. NUTRITION

Some important points :

- All NOVOGEN recommendations are made with a quality protein. That means with a good availability and digestibility of Amino Acids (A.A.). Any quality degradation (see raw materials chapter) must result in a proportional decrease in the A.A. matrix value in order to avoid any deficiency that would limit the genetic potential of the animals.
- Any anti-nutritional factors that may alter the bioavailability of A.A. must be controlled, taken into account in terms of risk and managed accordingly.
- There are many methods of defining available phosphorus, in particular because of the basic reference which may be different (monocalcium, anhydrous dicalcium, monosodium...). It is therefore necessary to adjust locally according to the field results.
- Chlorine level is more important to follow in alternative systems (you should be more strict). The maximum recommendation is in case of good droppings quality. If the droppings are too wet, you must decrease this maximum (in some case, until the minimum of sodium).
- These recommendations are given for an average temperature in husbandry between 20 and 22°C, an optimal breeding and material. That means when the birds will go outside (with lower temperature), they need more energy compare to other system of production. It is recommended in this case to increase the energy level with at least 1.8% more of energy (should be adjusted according to the situation).
- It is recommended, whenever possible, to formulate feeds in A.A-ratios, on the basis of lysine in order to avoid any imbalance (causing a greater need and losses due mainly to competition between A.A.).

	Pullets	Laying hens
Dig. Lysine	100	100
Dig. Methionine	48 / 50	52 / 58
Dig. Methionine+Cystine	76 / 80	85 / 90
Dig. Tryptophan	19 / 20	20 / 22
Dig. Threonine	68 / 74	66 / 74

These ratios are indicated by ranges, they are adjusted according to the observed field performances and the desired production objectives (typically feather, egg weight, etc.).

- Attention to the cumulative potential enzymatic valuations on A.A., protein and energy (see chapter enzymes in NOVOGEN nutrition guide).
- In comparison to cage system, it is recommended to increase energy level by 50 Kcal, protein by 0.5% and crude fiber by at least 1% at the onset of lay.

A minimum total fiber level is recommended for all their positive effects on the digestion and behaviour of the animals. The minimum level at 4.5% should be increase according to birds behavior. Increase at least to 0.5% or 1% if you begin to see any signs of aggression between birds.

NUTRITION

8.1. EXAMPLE OF DIET SPECIFICATIONS FOR REARING PERIOD

	Starter	Grower	Pullet / Developer	Pre-Lay
	0 - 5 weeks	6 - 10 weeks	11 - 15 weeks	16 weeks to 2%
	Crumble	Crumble or Mash	Coarse Mash	Coarse Mash
EM Kcal / Kg	2900 - 3000	2800 - 2900	2700 - 2800 (1)	2700 - 2750 (1)
EM Kcal / lb	1316 - 1362	1270 - 1316	1225 - 1270	1225 - 1247
% Crude protein	20.0 - 21.0	18.0 - 19.0	16.0 - 17.0	16.0 - 17.0
% Crude fiber	-	2.5 - 5.0	5.0 - 6.5	4.0 - 5.5
% Crude fat	3.5 - 5.5	3.0 - 4.5	2.5 - 4.0	2.5 - 4.5
% Tot. Lysine	1.12	0.97	0.75	0.81
% Tot. Methionine	0.51	0.45	0.35	0.41
% Tot. Methio + Cystine	0.86	0.76	0.67	0.70
% Tot. Tryptophan	0.22	0.20	0.17	0.19
% Tot. Threonine	0.77	0.67	0.57	0.59
% Dig. Lysine	1.00	0.86	0.67	0.72
% Dig. Methionine	0.48	0.42	0.33	0.37
% Dig. Meth & Cystine	0.76	0.67	0.58	0.62
% Dig. Tryptophan	0.19	0.17	0.15	0.16
% Dig. Threonine	0.68	0.58	0.48	0.50
% Calcium	1.00 - 1.10	1.00 - 1.10	0.95 - 1.05	2.20 - 2.50
% Available Phosphorus	0.45 - 0.50	0.40 - 0.45	0.37 - 0.40	0.42 - 0.45
% Sodium	0.17 - 0.20	0.16 - 0.18	0.16 - 0.18	0.17 - 0.19
% Chlorine	0.16 - 0.20	0.16 - 0.20	0.16 - 0.20	0.16 - 0.22
% Potassium	0.70 - 0.80	0.65 - 0.80	0.60 - 0.80	0.60 - 0.80

- (1) The energy level of the pullet feed 11 - 15 weeks and pre-lay should be equal to that of the laying feed at the beginning of lay.
- (2) In hot climates, it is recommended to increase amino acid levels by 5% in order to compensate for lower consumption.
- (3) If the birds go outside, energy level should be a little bit higher (must be adjusted according to the external temperature)

8.2. EXAMPLE OF DIET SPECIFICATIONS FROM 2% PRODUCTION TO 28 WEEKS

Ingested quantity (g/d)	Layer 1					
	Need g/ bird / day	100 ⁽¹⁾	105 ⁽¹⁾	110 ⁽¹⁾	115 ⁽¹⁾	120 ⁽¹⁾
% Crude protein	19.5	19.5	18.6	17.8	17.0	16.3
% Crude fiber	-	4.5 - 6.0				
% Crude fat	-	2.5 - 5.5				
% Tot. Lysine	-	0.94	0.89	0.85	0.81	0.78
% Tot. Methionine	-	0.49	0.47	0.45	0.43	0.41
% Tot. Methio + Cystine	-	0.82	0.78	0.75	0.71	0.68
% Tot. Tryptophan	-	0.22	0.21	0.20	0.19	0.18
% Tot. Threonine	-	0.69	0.66	0.63	0.60	0.58
% Tot. Isoleucine	-	0.85	0.81	0.77	0.74	0.71
% Tot. Valine	-	0.90	0.86	0.82	0.78	0.75
% Dig. Lysine	0.83	0.83	0.79	0.75	0.72	0.69
% Dig. Methionine	0.46	0.46	0.44	0.42	0.40	0.38
% Dig. Meth & Cystine	0.73	0.74	0.70	0.67	0.64	0.61
% Dig. Tryptophan	0.19	0.19	0.18	0.17	0.16	0.16
% Dig. Threonine	0.59	0.59	0.56	0.54	0.51	0.49
% Dig. Isoleucine	0.77	0.77	0.73	0.70	0.67	0.64
% Dig. Valine	0.82	0.82	0.78	0.74	0.71	0.68
% Calcium	4.20	4.20	4.00	3.80	3.65	3.50
% Available Phosphorus	0.42	0.42	0.40	0.38	0.37	0.35
% Sodium Min.	0.16	0.16	0.16	0.16	0.16	0.16
% Chlorine Max.	0.22	0.22	0.22	0.22	0.21	0.20
% Linoleic acid (Min.)	-	1.30	1.25	1.20	1.15	1.10

(1) The consumption levels listed above correspond to the usual observed consumption after 25 weeks.

For this period, we recommend to increase by 7% protein and amino acids to take into account both the needs of growth in addition to production needs and secondly, to take account of lower consumption observed during the beginning of this period.

NUTRITION

8.3. EXAMPLE OF DIET SPECIFICATIONS FROM 28 TO 45 WEEKS

Ingested quantity (g/d)	Layer 2					
	Need g/ bird / day	100	105	110	115	120
% Crude protein	18.5	18.5	17.7	16.9	16.3	15.5
% Crude fiber	-	4.5 - 6.5				
% Crude fat	-	2.0 - 4.5				
% Tot. Amino Acids						
% Tot. Lysine	-	0.88	0.84	0.80	0.76	0.73
% Tot. Methionine	-	0.46	0.44	0.42	0.40	0.38
% Tot. Methio + Cystine	-	0.77	0.73	0.70	0.67	0.64
% Tot. Tryptophan	-	0.21	0.20	0.19	0.18	0.18
% Tot. Threonine	-	0.64	0.61	0.58	0.56	0.53
% Tot. Isoleucine	-	0.79	0.75	0.72	0.69	0.66
% Tot. Valine	-	0.85	0.81	0.77	0.74	0.71
% Dig. Amino Acids						
% Dig. Lysine	0.78	0.78	0.74	0.71	0.68	0.65
% Dig. Methionine	0.43	0.43	0.41	0.39	0.37	0.36
% Dig. Meth & Cystine	0.69	0.69	0.66	0.63	0.60	0.58
% Dig. Tryptophan	0.18	0.18	0.17	0.16	0.16	0.15
% Dig. Threonine	0.55	0.55	0.52	0.50	0.48	0.46
% Dig. Isoleucine	0.72	0.72	0.69	0.66	0.63	0.60
% Dig. Valine	0.77	0.77	0.73	0.70	0.67	0.64
% Minerals						
% Calcium	4.20	4.20	4.00	3.80	3.65	3.50
% Available Phosphorus	0.40	0.40	0.38	0.36	0.35	0.33
% Sodium Min.	0.16	0.16	0.16	0.16	0.16	0.16
% Chlorine Max.	0.24	0.24	0.24	0.24	0.23	0.22
% Linoleic acid (Min.)	-	1.30	1.25	1.20	1.15	1.10

Fiber level must be adjusted according to the bird behavior (cf. our Novogen nutrition guide for more details)

NUTRITION

8.4. EXAMPLE OF DIET SPECIFICATIONS FROM 45 TO 70 WEEKS

Ingested quantity (g/d)	Layer 3					
	Need g/ bird / day	100	105	110	115	120
% Crude protein	18.0	18.0	17.2	16.4	15.7	15.1
% Crude fiber	-	4.5 - 7.0				
% Crude fat	-	1.5 - 3.5				
% Tot. Amino Acids						
% Tot. Lysine	-	0.90	0.86	0.82	0.78	0.75
% Tot. Methionine	-	0.46	0.44	0.42	0.40	0.38
% Tot. Methio + Cystine	-	0.77	0.73	0.70	0.67	0.64
% Tot. Tryptophan	-	0.21	0.20	0.19	0.18	0.18
% Tot. Threonine	-	0.64	0.61	0.58	0.56	0.53
% Tot. Isoleucine	-	0.79	0.75	0.72	0.69	0.66
% Tot. Valine	-	0.85	0.81	0.77	0.74	0.71
% Dig. Amino Acids						
% Dig. Lysine	0.80	0.80	0.76	0.73	0.70	0.67
% Dig. Methionine	0.43	0.43	0.41	0.39	0.37	0.36
% Dig. Meth & Cystine	0.69	0.69	0.66	0.63	0.60	0.58
% Dig. Tryptophan	0.18	0.18	0.17	0.16	0.16	0.15
% Dig. Threonine	0.55	0.55	0.52	0.50	0.48	0.46
% Dig. Isoleucine	0.72	0.72	0.69	0.66	0.63	0.60
% Dig. Valine	0.77	0.77	0.73	0.70	0.67	0.64
% Minerals						
% Calcium	4.50	4.50	4.30	4.10	3.90	3.75
% Available Phosphorus	0.38	0.38	0.36	0.34	0.33	0.32
% Sodium Min.	0.16	0.16	0.16	0.16	0.16	0.16
% Chlorine Max.	0.24	0.24	0.24	0.24	0.23	0.22
% Linoleic acid (Min.)	-	1.20	1.15	1.10	1.05	1.00

Fiber level must be adjusted according to the bird behavior (cf. our Novogen nutrition guide for more details)

NUTRITION**8.5. EXAMPLE OF DIET SPECIFICATIONS FROM 70 TO 85 WEEKS**

Ingested quantity (g/d)	Layer 4					
	Need g/ bird / day	100	105	110	115	120
% Crude protein	17.5	17.5	16.7	16.0	15.3	14.7
% Crude fiber	-	4.5 - 7.0				
% Crude fat	-	1.5 - 3.0				
% Tot. Amino Acids						
% Tot. Lysine	-	0.91	0.87	0.83	0.79	0.76
% Tot. Methionine	-	0.46	0.44	0.42	0.40	0.38
% Tot. Methio + Cystine	-	0.77	0.73	0.70	0.67	0.64
% Tot. Tryptophan	-	0.21	0.20	0.19	0.18	0.18
% Tot. Threonine	-	0.64	0.61	0.58	0.56	0.53
% Tot. Isoleucine	-	0.79	0.75	0.72	0.69	0.66
% Tot. Valine	-	0.85	0.81	0.77	0.74	0.71
% Dig. Amino Acids						
% Dig. Lysine	0.81	0.81	0.77	0.74	0.71	0.68
% Dig. Methionine	0.43	0.43	0.41	0.39	0.37	0.36
% Dig. Meth & Cystine	0.69	0.69	0.66	0.63	0.60	0.58
% Dig. Tryptophan	0.18	0.18	0.17	0.16	0.16	0.15
% Dig. Threonine	0.55	0.55	0.52	0.50	0.48	0.46
% Dig. Isoleucine	0.72	0.72	0.69	0.66	0.63	0.60
% Dig. Valine	0.77	0.77	0.73	0.70	0.67	0.64
% Minerals						
% Calcium	4.80	4.80	4.60	4.40	4.20	4.00
% Available Phosphorus	0.36	0.36	0.34	0.33	0.31	0.30
% Sodium Min.	0.16	0.16	0.16	0.16	0.16	0.16
% Chlorine Max.	0.25	0.25	0.25	0.24	0.23	0.22
% Linoleic acid (Min.)	-	1.20	1.15	1.10	1.05	1.00

Fiber level must be adjusted according to the bird behavior (cf. our Novogen nutrition guide for more details)

NUTRITION

8.6. EXAMPLE OF DIET SPECIFICATIONS FROM 85 WEEKS TO DEPLETION

Ingested quantity (g/d)	Layer 5					
	Need g/ bird / day	100	105	110	115	120
% Crude protein	17.25	17.25	16.5	15.7	15.1	14.5
% Crude fiber	-	4.5 - 7.0				
% Crude fat	-	1.0 - 2.5				
% Tot. Lysine	-	0.91	0.87	0.83	0.79	0.76
% Tot. Methionine	-	0.46	0.44	0.42	0.40	0.38
% Tot. Methio + Cystine	-	0.77	0.73	0.70	0.67	0.64
% Tot. Tryptophan	-	0.21	0.20	0.19	0.18	0.18
% Tot. Threonine	-	0.64	0.61	0.58	0.56	0.53
% Tot. Isoleucine	-	0.79	0.75	0.72	0.69	0.66
% Tot. Valine	-	0.85	0.81	0.77	0.74	0.71
% Dig. Lysine	0.81	0.81	0.77	0.74	0.71	0.68
% Dig. Methionine	0.43	0.43	0.41	0.39	0.37	0.36
% Dig. Meth & Cystine	0.69	0.69	0.66	0.63	0.60	0.58
% Dig. Tryptophan	0.18	0.18	0.17	0.16	0.16	0.15
% Dig. Threonine	0.55	0.55	0.52	0.50	0.48	0.46
% Dig. Isoleucine	0.72	0.72	0.69	0.66	0.63	0.60
% Dig. Valine	0.77	0.77	0.73	0.70	0.67	0.64
% Calcium	5.00	5.00	4.80	4.60	4.40	4.20
% Available Phosphorus	0.34	0.34	0.32	0.31	0.30	0.28
% Sodium Min.	0.16	0.16	0.16	0.16	0.16	0.16
% Chlorine Max.	0.25	0.25	0.25	0.24	0.23	0.22
% Linoleic acid (Min.)	-	1.20	1.15	1.10	1.05	1.00

9. HEALTH PROGRAMME

It is impossible to devise a health programme to adequately suit all geographic areas. For this reason, it is strongly recommended to consult a local specialist to establish a prevention programme adapted to the 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 details 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 :
 - control of disinfection, water and feed quality
 - serological monitoring
 - post mortem examination, routine parasite checks

9.1. VACCINATION




The vaccination programme has to be defined and regularly updated with a local veterinarian.

- Vaccine rules:
 - Only vaccinate healthy flock
 - Always check the conformity of the vaccines with the vaccination programme. In case of doubt, immediately contact your local veterinarian.
 - Keep records of vaccine serial numbers and expiry dates
 - Use clean and specific vaccination equipment
- Vaccine preparation:


Live vaccine	Inactivated vaccine
<ul style="list-style-type: none"> • Live vaccines are fragile and should be prepared with care. • Vaccine storage should be monitored, to make sure it is kept as per manufacturer recommendations (usually between 2 to 6°C). Regularly check the temperature of the storage equipment. • For freeze-dried vaccines, dilute the powder into mineral water or with the provided diluent if appropriate carefully injected with a syringe. • The quality of the water used for live vaccine should be checked: no disinfectant, suitable amount of iron, manganese and magnesium, no organic matter. 	<ul style="list-style-type: none"> • Inactivated vaccines are administered through adjuvants. The adjuvant can shock the birds if injected too cold, so it is advised to slowly warm them up before use (25 to 30°C). To ensure quality injection, needles should be sterile before use, and changed regularly. A good base number is to change every 1,000 birds, but more importantly make sure that it is not damaging the muscle as it would cause unnecessary pain and be detrimental to the vaccine up- take.

HEALTH PROGRAMME

Tables: Vaccination methods and description

VACCINATION METHODS	GENERAL DESCRIPTION
<p>Drinking water</p>	<ul style="list-style-type: none"> • Do not use disinfectant or chlorine in a period of 48 hours before vaccination and 24 hours after. • Check each drinkers condition and cleanliness • Cut the water around 2 hours before vaccination. It also depends on the current temperature (one should be more cautious in hot climates and use lesser time) • Prepare the vaccine: <ul style="list-style-type: none"> - Clean your hands - Prepare the required volume of water in a clean tank. A good base number is 15 to 20% of the previous day water consumption. - Neutralize the residual chlorine with Sodium Thiosulfate (16g/1000l water) mix and let it act for 10 minutes. - Mix the solution vaccine + diluent with the neutralized water for 1 minute • Distribute the vaccine • Let the birds drink the vaccine solution. It has to be consumed within 2 hours • During the distribution, walk among the birds to move them and stimulate drinking behaviour. • Once the vaccination solution has been consumed, give water without chlorine • To check the proper vaccine take, a water colorant can be used. More than 90% of the birds should have a coloured tongue after the distribution. <div style="text-align: right;"> <p>Photo : Drinking water vaccination installation</p>  <p>Photo : Coloured tongue</p>  </div>
<p>Spray</p>	<ul style="list-style-type: none"> • It is recommended to spray in the morning and in a calm atmosphere (avoid feed distribution right after the vaccination and dim the light). • Gather the birds • Turn off the ventilation and heating systems to avoid losses due to evaporation or dispersion • Preferably use mineral water • Check the condition and cleanliness of the spraying machine • Prepare the vaccine and fill up the spraying machine tank with the solution of vaccine and water • Spray at 30-40 cm high / Make sure the droplets size is adapted to the vaccine used / Spray along the whole building length back and forth/ Do not spray if the birds pills up • Wait for 5-10 minutes before switching the light, heating and ventilation systems back on <div style="text-align: right;"> <p>Photo : Spray vaccination</p>  </div>

HEALTH PROGRAMME

VACCINATION METHODS	GENERAL DESCRIPTION
<p>Subcutaneous / intramuscular injection</p>	<ul style="list-style-type: none"> • Use specific vaccination equipment • Set the syringe at the required dose: the dose corresponds to the dose of vaccine to be injected or, for mixed vaccine, the sum of the doses of mixed vaccines • Hold the birds by the wings and inject the vaccine at the indicated location • Regularly check the consumed volume of vaccine according to the number of vaccinated birds • Beware of defusing syringe when the bottle is getting empty • Regularly check the needle condition • Comfortable working conditions are the key to a successful vaccination
<p>Eye drop</p>	<ul style="list-style-type: none"> • Prepare the vaccine • Hold the bird to be vaccinated with the head tilted to one side • Drop one drop of vaccine into the eye. • Be sure the vaccine spreads over the eye before releasing the bird. <div data-bbox="1013 719 1474 1084" style="text-align: right;"> <p>Photo : Eye drop vaccination</p>  </div>
<p>Wing web</p>	<ul style="list-style-type: none"> • Use the provided stylet • Hold the bird on the side and spread the wing • The ideal transfixion area is in the wing membrane facing the elbow • Dip the stylet in the vial and insert it through the wing. • Avoid damaging the blood vessels.

HEALTH PROGRAMME

Tables: Applications of vaccines
(indicative only, check with your local veterinarian)

Basic vaccines applications		
Disease	Administration methods	Application periods
Marek	Intramuscular / subcutaneous / in-ovo	Day-old
Newcastle Disease (ND)	Drinking water / Spray / Subcutaneous / Intramuscular / in-ovo	Depending on the local epidemiological context this can start at day 1
Gumboro	Drinking water / in-ovo	Depending on the local epidemiological context and/or quantity of antibodies of maternal origin
Infectious Bronchitis (IB)	Drinking water / Spray / Subcutaneous / Intramuscular	Depending on the local epidemiological context, usually at day 1 with regular boosters
Avian encephalomyelitis (AE)	Drinking Water / Wing Web	Usually around 12 to 14 weeks of age

Optional vaccines applications		
Disease	Administration methods	Application periods
Coccidiosis	Spray / drinking water	Day-old
Infectious Laryngotracheitis (ILT)	Eye drop / Spray / Injection (recombinant vaccines) / in-ovo / Wing web	Depending on the vaccine and the local epidemiological context
Fowl Pox	Wing Web	8 to 12 weeks
Mycoplasmosis	Spray / Eye drop / Subcutaneous / Intramuscular	Depend on local epidemiological context and vaccine used
Salmonella	Drinking Water / Spray / Intramuscular	Usually based on live vaccines 6 weeks apart and a booster with inactivated 4 weeks before lay
Pasteurellosis	Wing web / Subcutaneous / Intramuscular	Depending on local epidemiological context
Infectious Coryza	Subcutaneous / intramuscular	Depending on local epidemiological context
Egg Drop Syndrome (EDS)	Subcutaneous / Intramuscular	Usually inactivated vaccine before lay

HEALTH PROGRAMME

9.2. PARASITES AND INSECTS MONITORING

The below tables give some indications on the main parasites and insects source of troubles in a layer poultry farm. The treatments have to be defined and regularly updated with a local veterinarian.

Table: Main parasites and insects in layer poultry farm

		DESCRIPTIONS	SIGNS	TREATMENT
Internal parasites	Ascaridia galli	<ul style="list-style-type: none"> - Roundworm that can measure up to 12 cm - It is the most common layer parasite - Adult female lays eggs in the intestine that pass in the faeces. - Contamination by eggs ingestion, the larvae reaches the infectious stage after 2-3 weeks. The adult can live for one year. 	<ul style="list-style-type: none"> - anaemia, intermittent diarrhoea, bodyweight loss, egg production decrease, loss of fertility in males 	<ul style="list-style-type: none"> - Litter sanitation measures - Strict cleaning and disinfection between two flocks - Chemical treatment: Benzimidazoles, avermectins, levamisole, etc...
	Capilaria	<ul style="list-style-type: none"> - Threadworm that can measure up to 8 cm - Parasite from the digestive tract located in the oesophagus, crop, small intestine or caecum according to the species. - The eggs pass in the faeces and reach the infectious stage within 3-4 weeks - After ingestion, it can produce severe inflammation and sometimes haemorrhage - More common problem in deep litter houses 	<ul style="list-style-type: none"> - Young birds are more sensitive - Bodyweight loss, apathy, egg production decrease, can lead to death 	<ul style="list-style-type: none"> - Litter sanitation measures - Strict cleaning and disinfection between two flocks - Chemical treatment: Benzimidazoles, avermectins, levamisole, etc...
	Cestodes	<ul style="list-style-type: none"> - Tapeworm that can measure up to 4 cm. - Their development cycle includes an intermediate host (insect, snails, slugs, beetles, ants, earthworms, houseflies...). The hens are being infected by eating this host. Consequently, this parasite is uncommon in closed house farm. - Once in the intestine, it reaches its maturity at around 3 weeks of age. 	<ul style="list-style-type: none"> - In case of heavy infection: bodyweight loss, feed intake decrease specially with young birds, egg production decrease 	<ul style="list-style-type: none"> - Litter sanitation measures - Strict cleaning and disinfection between two flocks - Chemical treatment is usually based on praziquantel

HEALTH PROGRAMME

		DESCRIPTIONS	SIGNS	TREATMENT
External parasites	Red Mites	<ul style="list-style-type: none"> - Blood sucking during night periods - Remain hidden in cracks and crevices during the light periods. - About a day after feeding, the female lays eggs in cracks and crevices of the house - Fast increase of population 	<ul style="list-style-type: none"> - Behaviour modification due to the disturbance (pecking, nervousness...) - Egg production decrease - Anaemia that can induce higher mortality and FCR increase - Blood stains on the egg shell - To be detected and treated as soon as possible to avoid heavy infection by using specific trap 	<ul style="list-style-type: none"> - Chemical products: <ul style="list-style-type: none"> Organophosphorus based (phoxim, azametiphos, dichlorvos...) Pyrethroids based (cyfluthrin, permethrin...) Spinosad based - Natural products: <ul style="list-style-type: none"> Silica, sodium bicarbonate, extracts and essential oils of medicinal and aromatic plants... - Cyclic lighting programme (when allowed) - Importance of cleaning and disinfection measures between two flocks
	Insects	Fly (<i>Musca domestica</i>)	<ul style="list-style-type: none"> - Female can lay up to 1000 eggs and start laying 4 to 8 days after mating. - Egg development is optimum in manure with 40-70% humidity. - Larvae are feeding on decomposing organic matter - Adults can live 2 weeks in summer and up to 2 to 3 months in winter. 	<ul style="list-style-type: none"> - Passive agent of pathogens spread (virus, bacteria, parasites) - Disturb the hens and reduce the egg production - Flies dropping increase the number of second grade eggs
	Darkling beetles	<ul style="list-style-type: none"> - Female can lay up to 800 eggs - Larvae burrow into the ground for insulation as they pupate - Life cycle (from egg to adulthood) of 2 months to a year depending on season and temperature 	<ul style="list-style-type: none"> - Passive carrier of pathogens (Marek virus, salmonella, E. Coli, aspergillus...) - Penetrate in insulation equipment causing heavy damages 	<ul style="list-style-type: none"> - Strict cleaning and disinfection between two flocks - Chemical treatment should target adults (preferably on the walls), and the larvae (preferably on the litter, under the feeding pans and/or drinkers)

10. LITTER

10.1. LITTER QUALITY

Depending on the system, litter can be used to cover the floor in rearing. The main materials used for litter are chopped straw (wheat, barley...) and wood shaving. It is recommended to use wood shaving coming from non treated wood. Depending on the local availabilities, other material like rice hull and cellulose pellet can also be used. The choice of the litter is an important component on the success of rearing by ensuring a comfortable environment while avoiding potential disease conditions. Moreover, litter is used by birds for dust bathing, foraging and scratching, which help reduce feather picking.

Photo: Wood shaving litter in rearing



Different qualities must be taken into account for the choice of the litter:

- Thermal insulation from the cold coming from the ground. It depends of the litter material and depth. It is very important during the first week, as long as the chicks are poikilotherm.
- Absorption of humidity from manure and birds breath. It is particularly important in cold and wet weather when ventilation is low.
- Low level of dust to avoid respiratory disease.
- Safe for the chicks by avoiding being a source of contamination (virus, bacteria, mould).
- Comfortable and not harmful for the chicks

Ensure the shed is fully warmed before distributing the litter. If the gap of temperature between the floor and the room is too important, ie the floor is not warm enough, litter will become stick and wet from below.

10.2. LITTER MANAGEMENT

In order to maintain an optimal litter quality all along the flock:

- Keep under control litter humidity
- Avoid any leaking or spillage from water system (nipples, bell drinkers...).
- Floor system:
 - In rearing, litter depth should be 5 cm high
 - Additional fresh litter can be distributed on top of the existing litter to keep low moisture content
- Aviary system:
 - 2 cm of litter is sufficient.
 - In production, excess of litter should be frequently removed to avoid the floor area to be too comfortable as it could induce some floor laid eggs. It also allow to reduce dust content.

FINE DUST MANAGEMENT

11. FINE DUST MANAGEMENT

The presence of dust in production houses is an inescapable consequence of alternative production. The hens have more possibilities to move inside the house which increase physical interaction with their environment.

A research in the Netherlands from Winkel and Albert (2016) has showed that while layer market has been changing from 99% cage production in 1995, towards 95% alternative production in 2014 the fine dust emission (PM₁₀) by poultry farm in the country has been increasing by 5 times.

One of the main challenge for poultry farmers and the poultry sector is how to manage the fine dust production in order to avoid its impact on farm workers and public health. With the rise of alternative production and the increase of fine dust production in North-West Europe, climate and poultry equipment suppliers have specialized themselves in the search of fine dust reducing equipment. The available equipment can be categorised in 4 main groups, which are presented below. The investments and fixed annual cost are varying according to equipment.

Table: Fine dust reducing equipment

Fine dust reducing equipment	Principal	Fine dust reducing capacity
Heat exchangers	The temperature of the incoming air is increased with the in house temperature. Condensation will be produced at the heat exchanger which is mixed with fine dust. Other principals with dust filters are also available.	+
Filters	The inhouse air or the outgoing air goes over a filter which separate the dust from the air. Different filter systems (paper, biofilter, synthetic, etc.) are available. The effect differs, based on the air movement, the available filter surface and the frequency to change/clean filter systems	+++
Dry-or manure tunnel	Most alternative production houses have manure collecting belts at the back side of the production house. The manure must be dried before it can be transported for other purposes. The air from the production house with the fine dust can be used for this. Because the manure is wet, it will bind the fine dust.	++
Ionization	The inhouse air or the outgoing air is ventilated over ionization equipment. The positive or negative tension creates a field of loaded ionen which move to the grounded equipment. The fine dust binds to the loaded ionen.	+++

12. PASTURE MANAGEMENT

Free range systems requires a specific pasture management in order to optimize its exploration by hens.

Benefits of a well-managed pasture are multiple:

- Animal welfare by allowing hens to express their natural exploration behaviour.
- Lower sanitary risk, specially parasite infections.
- Better distribution of faeces in the land reducing accumulation of phosphorus and nitrogen in crowded area.
- Lower hens physical effect on the grass.
- Optimization of landscape integration with plantations.

Pasture is not a natural environment for layers hens. Plantations and shelters are necessary to encourage hens to explore the pasture for the following reasons:

- Supplying of shadow area.
- Protection from the wind.
- Guide birds movement.
- Protection from rapacious.

12.1. OPTIMIZATION OF PASTURE EXPLORATION

Different areas can be distinguished requiring a specific management:

- House and its surroundings:
 - House should be slightly over elevated from ground level to avoid possible water infiltration inside the house which could alterate litter quality.
 - Use connected gutter and drain around the house to reduce water and mud accumulation.
 - A concrete pavement in front of the pop holes helps to keep a clean area.
- House exit area(up to 15m from the house)
 - This is the first area explored by hens.
 - It must be clean, conformable and protected from the wind.
 - A too shaded area will not be attractive for birds.
 - To avoid feces accumulation, it should only be a transit area.
- Intermediary and background area (from 15 to 40m from the house)
 - Once hens get out of the house, target is to encourage them to explore further and reach the intermediary area.
 - In these areas, plantations should provide shelters from predators, protect from the wind and provide shadow areas. It is often recommended to mix bushes and trees plantations.
 - These areas should also be drained to avoid water accumulation.

PASTURE MANAGEMENT

12.2. MANAGEMENT OF PARASITIC RISK

Pasture is a risk area regarding pathogens and parasites contaminations. They are brought by hens feces as well as rodents and wild birds.

Coccidiosis is often the main parasite found but ascaris, capilaria, tenia can also be present.

Logically, the most used area are the most contaminated. Therefore, it is recommended to avoid environments favourable to the development of these parasites:

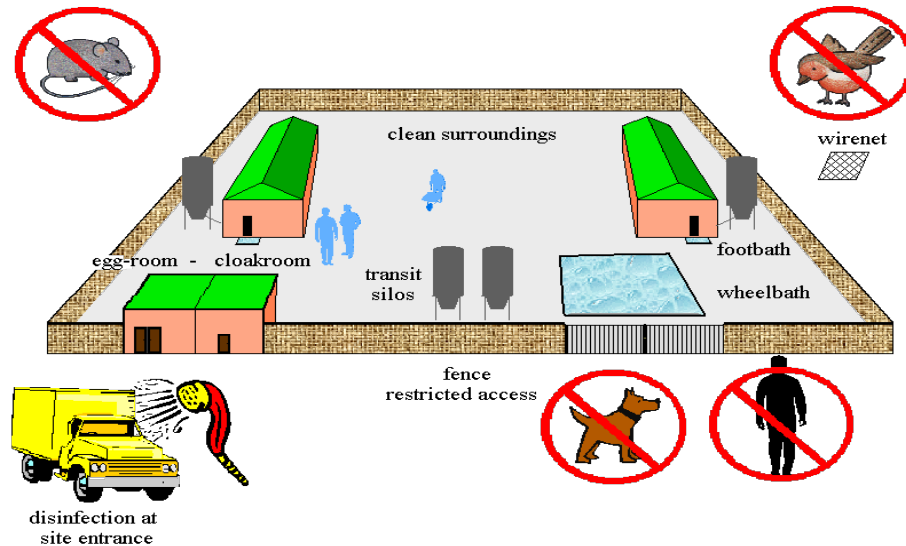
- Avoid any wet area with a good draining of the pasture, house surrounding and gutter connections.
- Good quality fences reduce entrance of rodents.
- The most crowded area, specially house surrounding, must be disinfected between 2 flocks with quick lime (400kg / 1000m²) or caustic soda (50 to 100kg / 1000m²).

GENERAL FARM RULES

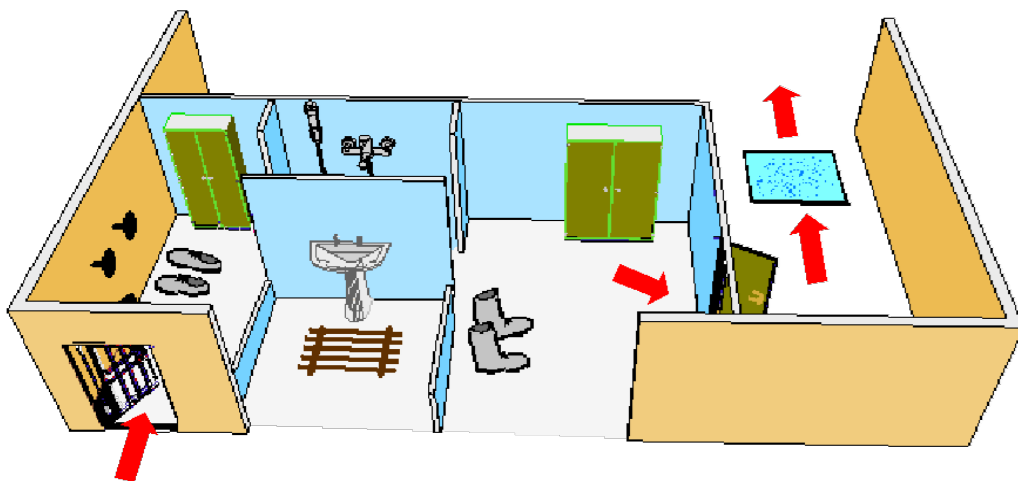
13. GENERAL FARM RULES

Ideally, the best rule of 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

14. 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.

14.1. OPERATIONS PRIOR TO CLEANING

- Water tank, pipes and nipples:
 - Empty the complete water system.
 - 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.

14.2. WASHING

When washing, ensure local regulations regarding wash down water are observed. As a 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 (>50kg/cm²) 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).

CLEANING AND DISINFECTION OF POULTRY HOUSES

14.3. PLACING EQUIPMENT BACK INTO THE HOUSE

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

14.4. 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 the manufacturer's guidelines.
- Heating and ventilation ducts (if they are present)
 - Disinfection using fungicidal, virucidal and bactericidal candles following manufacturer's guidelines.
- House surroundings and road and path access ways.
 - Spread a disinfecting product, such as:
 - caustic soda (50 to 100 kg/1000 m²).
 - or quicklime (400 kg/1000 m²).

14.5. SANITARY PRECAUTIONS

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

14.6. 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.

14.7. 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.

CLEANING AND DISINFECTION OF POULTRY HOUSES

14.8. 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.

14.9. 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.
- To be careful with disinfection fo vehicles coming to the farm

PERFORMANCE TABLES

15. PERFORMANCE TABLES

15.1. REARING TABLE

Age (Week)	Age (Days)	Consumption in g/bird	Female BodyWeight (gr)	
			Min.	Max.
1	0 to 7	10	70	75
2	8 to 14	15	125	130
3	15 to 21	22	190	200
4	21 to 28	31	270	285
5	29 to 35	35	345	365
6	36 to 42	41	425	450
7	43 to 49	45	500	530
8	50 to 56	48	575	605
9	57 to 63	51	650	685
10	64 to 70	53	720	760
11	71 to 77	55	790	835
12	78 to 84	57	855	905
13	85 to 91	60	920	970
14	92 to 98	63	980	1 035
15	99 to 105	66	1 045	1 105
16	106 to 112	69	1 110	1 170
17	113 to 119	72	1 170	1 235
18	120 to 126	75	1 230	1 300

PERFORMANCE TABLES

15.2. PRODUCTION TABLE

Age	Body Weight (min)	Daily Feed Intake	Lay	Mortality	Cum. Eggs	Average Egg Weight	Weekly egg mass /HH	Cum. Egg mass	FCR (119 days)	FC (119 days)
Week	g	g/bird	%	%	/HH	g	g	g	kg/kg	g/egg
18	1230	78,0	0,0	0,1	0	0,0	0,0	-	0,00	0,0
19	1290	83,0	3,0	0,2	0	42,0	8,8	9	127,84	5369,3
20	1335	88,0	25,0	0,3	2	47,5	82,9	92	18,97	890,0
21	1375	94,0	60,0	0,4	6	50,0	209,2	301	7,96	390,2
22	1420	98,0	82,0	0,5	12	51,6	294,7	596	5,17	259,7
23	1455	102,0	90,0	0,6	18	53,1	332,5	928	4,08	209,1
24	1485	106,0	93,5	0,7	25	54,2	352,1	1 280	3,53	183,8
25	1510	109,0	94,5	0,8	31	55,4	363,5	1 644	3,21	169,4
26	1535	111,0	95,2	0,9	38	56,3	371,9	2 016	3,00	160,2
27	1560	111,0	95,5	1,0	44	57,0	377,2	2 393	2,85	153,6
28	1575	111,0	95,5	1,1	51	57,6	380,8	2 774	2,74	148,8
29	1585	111,0	95,5	1,2	58	58,1	383,7	3 157	2,65	145,0
30	1595	111,0	95,5	1,3	64	58,6	386,6	3 544	2,57	142,1
31	1597	111,0	95,5	1,4	71	59,0	388,9	3 933	2,51	139,7
32	1600	111,0	95,5	1,5	77	59,4	391,1	4 324	2,46	137,7
33	1605	111,0	95,5	1,6	84	59,7	392,7	4 717	2,42	136,0
34	1610	111,0	95,5	1,7	91	59,9	393,6	5 110	2,38	134,6
35	1615	111,0	95,5	1,8	97	60,1	394,5	5 505	2,35	133,3
36	1619	111,0	95,4	1,9	104	60,3	395,0	5 900	2,32	132,3
37	1623	111,0	95,3	2,0	110	60,5	395,5	6 296	2,30	131,3
38	1627	111,0	95,2	2,1	117	60,6	395,4	6 691	2,28	130,5
39	1631	111,0	95,1	2,2	123	60,7	395,2	7 086	2,26	129,8
40	1635	111,0	95,0	2,3	130	60,8	395,0	7 481	2,24	129,1
41	1636	111,0	94,9	2,4	136	60,9	394,8	7 876	2,22	128,5
42	1636	111,0	94,7	2,5	143	61,1	394,9	8 271	2,21	128,0
43	1637	111,0	94,5	2,6	149	61,3	395,0	8 666	2,20	127,6
44	1637	111,0	94,3	2,7	156	61,5	395,0	9 061	2,18	127,2
45	1638	111,0	94,1	2,8	162	61,7	395,0	9 456	2,17	126,8
46	1638	111,0	93,9	2,9	168	61,8	394,4	9 850	2,16	126,5
47	1639	111,0	93,7	3,0	175	61,9	393,8	10 244	2,15	126,2
48	1639	111,0	93,5	3,1	181	62,0	393,2	10 637	2,14	125,9
49	1640	111,0	93,3	3,2	187	62,2	393,2	11 031	2,13	125,7
50	1640	111,0	93,1	3,3	194	62,3	392,6	11 423	2,13	125,5
51	1641	111,0	92,9	3,4	200	62,4	392,0	11 815	2,12	125,3
52	1641	111,0	92,7	3,5	206	62,5	391,4	12 206	2,11	125,1
53	1642	111,0	92,5	3,6	212	62,6	390,7	12 597	2,11	125,0
54	1642	111,0	92,3	3,7	219	62,7	390,1	12 987	2,10	124,8
55	1643	111,0	92,1	3,8	225	62,8	389,5	13 377	2,10	124,7
56	1643	111,0	91,9	3,9	231	62,9	388,9	13 766	2,09	124,6
57	1644	111,0	91,7	4,0	237	63,0	388,2	14 154	2,09	124,5
58	1644	111,0	91,4	4,1	243	63,1	387,2	14 541	2,08	124,4



PERFORMANCE TABLES

Age	Body Weight (min)	Daily Feed Intake	Lay	Mortality	Cum. Eggs	Average Egg Weight	Weekly egg mass /HH	Cum. Egg mass	FCR (119 days)	FC (119 days)
Week	g	g/bird	%	%	/HH	g	g	g	kg/kg	g/egg
59	1645	111,0	91,1	4,2	249	63,2	386,1	14 927	2,08	124,4
60	1645	111,0	90,8	4,3	256	63,3	385,0	15 312	2,07	124,3
61	1646	111,0	90,5	4,4	262	63,4	384,0	15 696	2,07	124,3
62	1647	111,0	90,2	4,5	268	63,5	382,9	16 079	2,07	124,3
63	1648	111,0	89,9	4,6	274	63,6	381,8	16 461	2,07	124,2
64	1649	111,0	89,6	4,7	280	63,7	380,7	16 842	2,06	124,2
65	1650	111,0	89,3	4,8	286	63,8	379,7	17 221	2,06	124,2
66	1651	111,0	89,0	4,9	291	63,8	378,0	17 599	2,06	124,2
67	1652	111,0	88,6	5,0	297	63,9	376,5	17 976	2,06	124,3
68	1653	111,0	88,2	5,1	303	63,9	374,4	18 350	2,05	124,3
69	1654	111,0	87,8	5,2	309	64,0	372,9	18 723	2,05	124,3
70	1655	111,0	87,4	5,3	315	64,0	370,8	19 094	2,05	124,4
71	1656	111,0	87,0	5,4	321	64,1	369,3	19 463	2,05	124,4
72	1657	111,0	86,6	5,5	326	64,1	367,2	19 830	2,05	124,5
73	1658	111,0	86,1	5,6	332	64,2	365,3	20 196	2,05	124,6
74	1659	111,0	85,6	5,7	338	64,2	362,8	20 558	2,05	124,7
75	1660	111,0	85,1	5,8	343	64,3	360,8	20 919	2,05	124,8
76	1661	111,0	84,6	5,9	349	64,3	358,3	21 278	2,05	124,9
77	1662	111,0	84,1	6,0	354	64,4	356,4	21 634	2,05	125,0
78	1663	111,0	83,5	6,1	360	64,4	353,5	21 987	2,05	125,1
79	1664	111,0	82,9	6,2	365	64,5	351,1	22 338	2,05	125,2
80	1665	111,0	82,3	6,3	371	64,5	348,2	22 687	2,05	125,4
81	1665	111,0	81,7	6,4	376	64,6	345,8	23 032	2,05	125,5
82	1665	111,0	81,1	6,5	381	64,6	342,9	23 375	2,05	125,7
83	1665	111,0	80,5	6,6	387	64,7	340,5	23 716	2,05	125,8
84	1665	111,0	79,9	6,7	392	64,7	337,6	24 053	2,05	126,0
85	1665	111,0	79,2	6,8	397	64,8	334,8	24 388	2,05	126,2
86	1665	111,0	78,5	6,9	402	64,8	331,5	24 720	2,06	126,4
87	1665	111,0	77,8	7,0	407	64,9	328,7	25 049	2,06	126,6
88	1665	111,0	77,1	7,1	412	64,9	325,4	25 374	2,06	126,8
89	1665	111,0	76,4	7,2	417	65,0	322,6	25 696	2,06	127,0
90	1665	111,0	75,7	7,3	422	65,0	319,3	26 016	2,06	127,3
91	1665	111,0	75,0	7,4	427	65,1	316,5	26 332	2,07	127,5
92	1665	111,0	74,3	7,5	432	65,1	313,2	26 645	2,07	127,7
93	1665	111,0	73,5	7,6	437	65,1	309,5	26 955	2,07	128,0
94	1665	111,0	72,7	7,7	441	65,2	306,3	27 261	2,08	128,3
95	1665	111,0	71,9	7,8	446	65,2	302,6	27 564	2,08	128,5
96	1665	111,0	71,1	7,9	450	65,2	298,9	27 863	2,08	128,8
97	1665	111,0	70,3	8,0	455	65,3	295,6	28 158	2,09	129,1
98	1665	111,0	69,5	8,1	459	65,3	292,0	28 450	2,09	129,4
99	1665	111,0	68,7	8,2	464	65,3	288,3	28 738	2,09	129,7
100	1665	111,0	67,9	8,3	468	65,4	285,0	29 024	2,10	130,0



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