Management Guide

novogen

COMMERCIAL LAYERS

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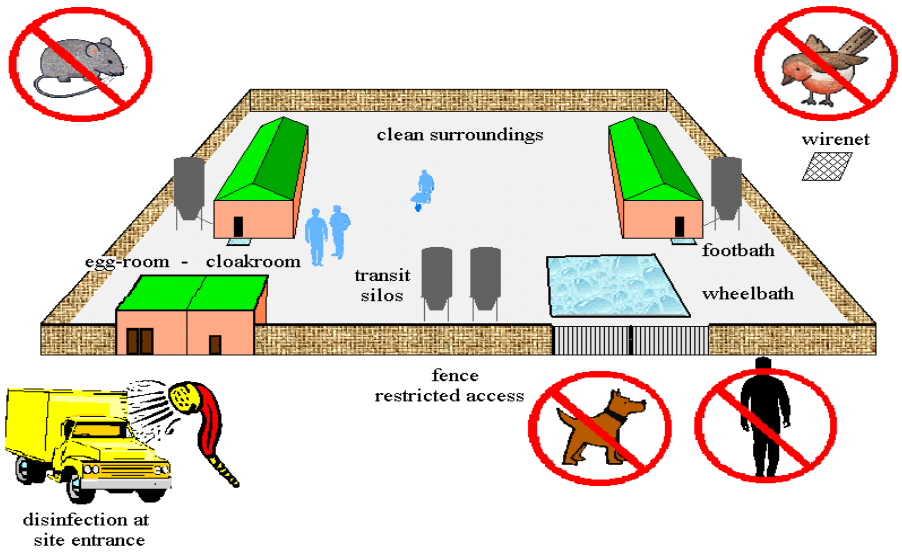
Content

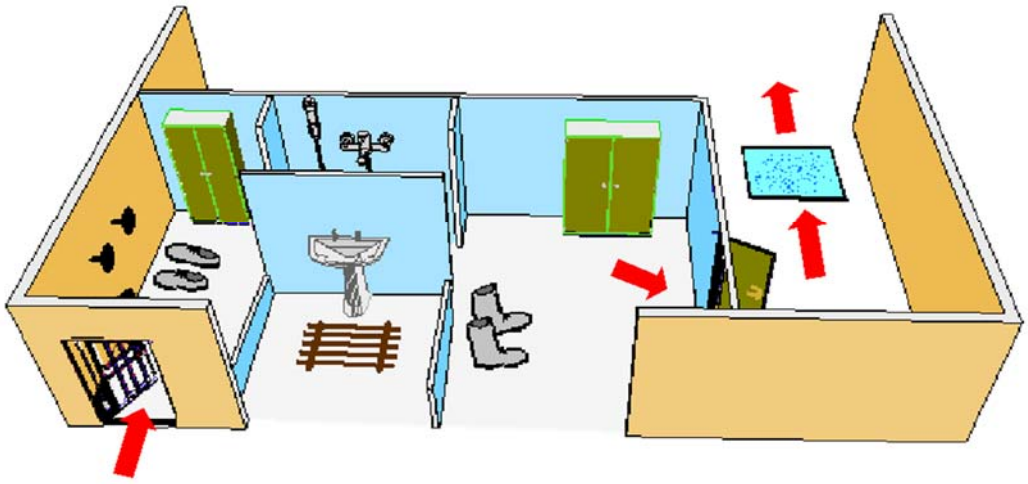
Content

➢ 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.

➢ FLOCK MANAGEMENT DURING THE REARING PERIOD

During this period, it is necessary to reach the target bodyweight and flock uniformity to prepare the birds for the production period. 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:

- 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, temperature, beak trimming…)
- Lighting programme
- Monitoring bodyweight and uniformity
- Nutrition
- Biosecurity and vaccination

• 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; especially for aviary/multi-tier systems, where young pullets have to be trained for a quick adaptation to use the equipment on different levels.

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

Photos: Cage rearing system

➢ FLOCK MANAGEMENT DURING THE REARING PERIOD

Photos: Floor rearing system

Photos: Aviary rearing system

➢ FLOCK MANAGEMENT DURING THE REARING PERIOD

• Stocking density, drinker space and feeding space from day-old to 2 weeks of age

	ALTERNATIVE SYSTEMS		CAGE SYSTEMS	
	Temperate climate	Hot climate	Temperate climate	Hot climate
Stocking density	30 birds/m^2	25 birds/m^2	50 birds/m^2	45 birds/m^2
Starter drinkers	1 / 80 chicks	1 / 70 chicks	1 / 50 chicks	1 / 50 chicks
Bell drinkers	1 / 150 birds	1 / 150 birds		
Nipple drinkers	1 / 12 birds	1 / 10 birds	1 / 15 birds	1 / 10 birds
Starting feed pans	1 / 50 chicks		1 / 50 chicks	
Linear chain feeders	2.5 cm / birds		2.5 cm / birds	
Pan feeders	1 / 30 birds		1 / 30 birds	

- **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

- **Starting in cages:**
  - pay attention on drinking system
  - Have a light intensity high enough for the chicks to find the nipple drinkers or water system
  - Make sure that the relative humidity is 55 to 60 % to prevent dehydration of the chicks
  - Use paper on the bottom of the cage to improve the ease of movement and comfort of the chick for the first few days

• Stocking density, drinker space and feeding space from 2 to 5 weeks of age

	ALTERNATIVE SYSTEMS		CAGE SYSTEMS	
	Temperate climate	Hot climate	Temperate climate	Hot climate
Stocking density	15 birds/m^2	15 birds/m^2	40 birds/m^2	30 birds/m^2
Bell drinkers	1 / 100 birds	1 / 75 birds		
Nipple drinkers	1 / 12 birds	1 / 10 birds	1 / 15 birds	1 / 10 birds
Linear chain feeders	4 cm per bird		4 cm per bird	
Pan feeders	1 / 25 birds		1 / 25 birds	

➢ FLOCK MANAGEMENT DURING THE REARING PERIOD

- **Stocking density, drinker space and feeding space between 5 weeks of age and transfer**

	ALTERNATIVE SYSTEMS		CAGE SYSTEMS	
	Temperate climate	Hot climate	Temperate climate	Hot climate
Stocking density	12-14 birds/m^2	8-10 birds/ m^2	25 birds/m^2	20 birds/m^2
Hanging drinkers	1 / 100 birds	1 / 75 birds	1 / 100 birds	1 / 70 birds
Nipple drinkers	1 / 12 birds	1 / 10 birds	1 / 12 birds	1 / 10 birds
Linear chain feeders	6 cm per bird		6 cm per bird	
Pan feeders	1 / 25 birds		1 / 25 birds	

- **Management of the temperature during the rearing period**

	Under the brooder	Near the circular guard	Room temperature	Relative humidity
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			21 – 20 °C	60 – 65 %
Week 6			20 – 19 °C	60 – 65 %
Week 7			19 – 18 °C	60 – 70 %
Week 8			19 – 17 °C	60 – 70 %
Till transfer			19 – 17 °C	60 – 70 %

Important points:

- 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 is fully warmed before placement.
- 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.
- Ensure proper ventilation from the moment the chicks arrive. Minimum ventilation during the brooding period = 0.5 m^3 per kg liveweight per hour. Unless there are cold air drafts in the house, use wire mesh fences or surrounds instead of cardboard.
- If brooding takes place in only part of the house, do not exceed a stocking density of 25 chicks per available m^2. Thus allowing chicks to spread quickly over the whole house within the first 7 days.
- 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.

➢ FLOCK MANAGEMENT DURING THE REARING PERIOD

- Check the distribution and behaviour of the chicks to enable you to adapt and manage the temperature of the House:
  - Good distribution and activity → correct temperature and climate
  - Chicks cuddle and/or avoid large areas of the barn → temperature is too low
  - Chicks are panting and are lying on the ground with their wings spread → temperature is too high

Photos: Checking of chicks temperature

- **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): 3 to 5 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

- This is thrown on the litter, a few hours before the dark period

➢ LIGHTING PROGRAMME

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 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

PERIOD	LIGHT SCHEDULE
During 4 days	• 4 hours light • 2 hours darkness • 4 hours light • 2 hours darkness
After 4 days	• 8 hours light • 2 hours darkness • 4 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 plateau 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.

- **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).

• 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 1,125-1,185 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 16 weeks of age.
  - Increase light duration by 2 hours when body weight is between 1,125-1,185 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 16 weeks of age.
  - Increase light duration by 2 hours at 1,125-1,185 g of bodyweight when there is a decreasing day length.
  - Increase light duration by 1 hour at 1,125-1,185 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.

➢ LIGHTING PROGRAMME

- 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 16 weeks of age.
  - Increase light duration by 2 hours at 1,125-1,185 g of bodyweight when there is a decreasing day length.
  - Increase light duration by 1 hour at 1,125-1,185 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.
- 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

- **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	**1,125-1,185**		**11.00**	**5-15 lux**
18	120 to 126	**1,190-1,255**	**0-1%**	**12.00**	**5-15 lux**
19	127 to 133	1,250-1,320	0-10%	**13.00 (2)**	**5-15 lux**
20	134 to 140	1,315-1,390	10-30%	**13.30**	**5-15 lux**
21	141 to 147	1,365-1,440	35-60%	**14.00**	**5-15 lux**
22	148 to 154	1,405-1,482	60-85%	**14.30**	**5-15 lux**
23	155 to 161	1,450-1,530	80-90%	**15.30**	**5-15 lux**
24	162 to 168	1,485-1,570	85-92%	**15.30 (3)**	**5-15 lux**
25	169 to 175	1,515-1,600	90-95%	**15.30 (3)**	**5-15 lux**
25 +	176 to 182	1,545-1,630		**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

➢ LIGHTING PROGRAMME

- **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)**	**1200. (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	**1,125-1,185**		**+2.00 (or 16.00)**	**+1.00 (or 16.00)**
18	120 to 126	**1,190-1,255**	**0-2%**	**+1.00 (or 16.00)**	**+1.00 (or 16.00)**
19	127 to 133	1,250-1,320	2-25%	**+1.00 (or 16.00) (1)**	**+1.00 (or 16.00)**
20	134 to 140	1,315-1,390	30-55%	**+0.30 (or 16.00)**	**+1.00 (or 16.00)**
21	141 to 147	1,365-1,440	55-82%	**+0.30 (or 16.00)**	**+0.30 (or 16.00)**
22	148 to 154	1,405-1,482	80-90%	**+0.30 (or 16.00)**	**+0.30 (or 16.00)**
23	155 to 161	1,450-1,530	85-93%	**+0.30 (or 16.00)**	**+0.30 (or 16.00)**
24	162 to 168	1,485-1,570	88-94%	**16.00**	**+0.30 (or 16.00)**
25	169 to 175	1,515-1,600	90-95%	**16.00**	**16.00**
25+	176 to 182	1,545-1,630			

NDL: Natural Day Length

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

➢ LIGHTING PROGRAMME

- **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	**1,125-1,185**		**12.00 (or NDL)**
18	120 to 126	**1,190-1,255**	**0-2%**	**12.00 (or NDL)**
19	127 to 133	1,250-1,320	2-25%	**+ 1.00 (1)**
20	134 to 140	1,315-1,390	30-55%	**+1.00**
21	141 to 147	1,365-1,440	55-82%	**+ 1.00**
22	148 to 154	1,405-1,482	80-90%	**+ 0.30**
23	155 to 161	1,450-1,530	85-93%	**+0.30 (or 16.00)**
24	162 to 168	1,485-1,570	88-94%	**16.00**
25	169 to 175	1,515-1,600	90-95%	**16.00**
25+	176 to 182	1,545-1,630		

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

• 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 close as possible to the temperature experienced by the pullets at the end of the rearing period.

• 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.

• 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.

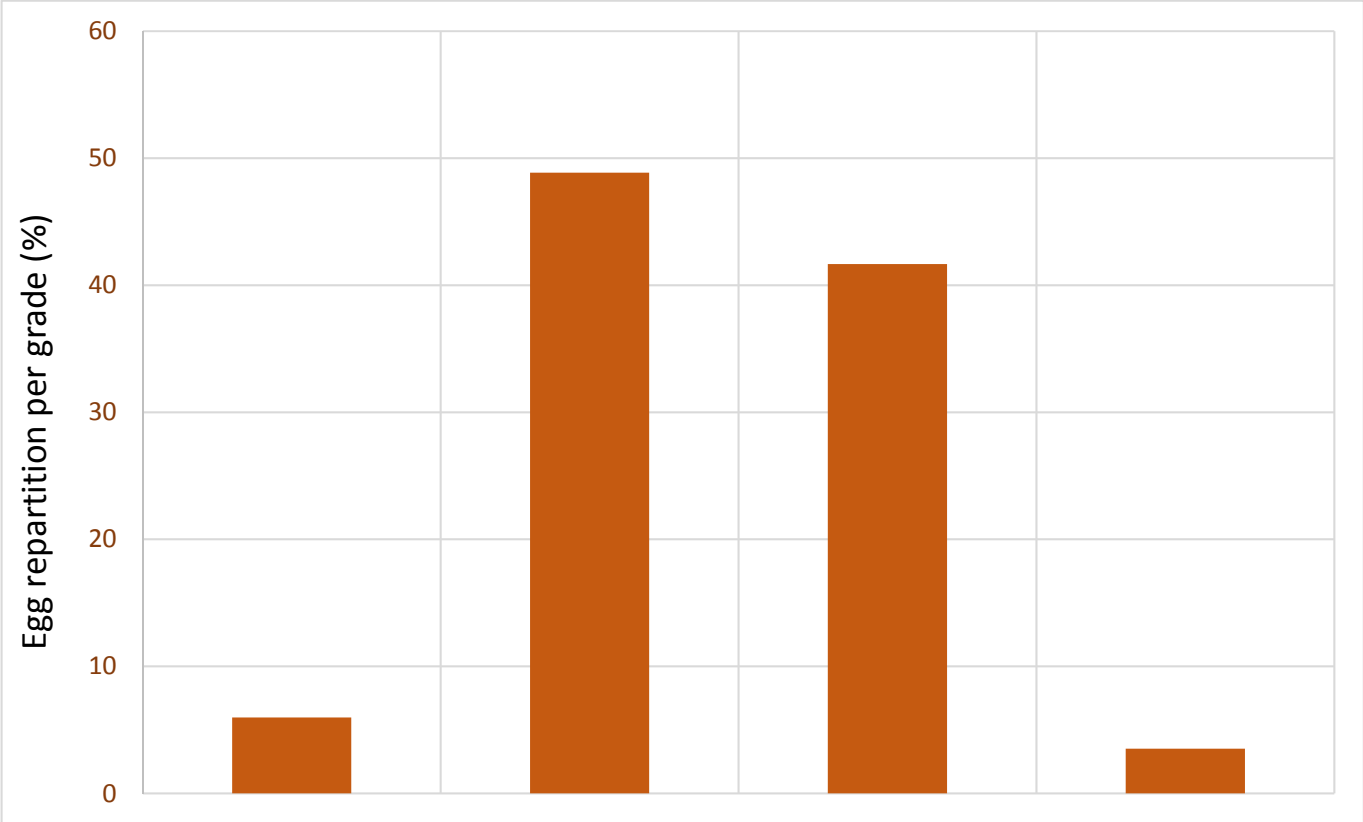
• Management of egg weight

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
- Setting up a cyclic lighting programme during the production period (when allowed by the local regulation) may increase the average egg weight under certain conditions.
  - 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

➢ FLOCK MANAGEMENT DURING THE PRODUCTION PERIOD

Graph: Cumulative NOVOgen White 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

• 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 50 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.

- 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 ort in order to satisfy their specific calcium appetite. A fraction of this calcium intake is stored in the crop. 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 into consuming 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 feed management 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

Photo: Shell colour measure

➢ 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 (4 – 6 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)

• 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 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 the growing curve chart. The analysis of the growing curve helps to accurately adjust the feed allowance (the quantities indicated in our Feed section are only to be considered as a guideline) and when required, to take the appropriate steps to correct the uniformity.

• 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

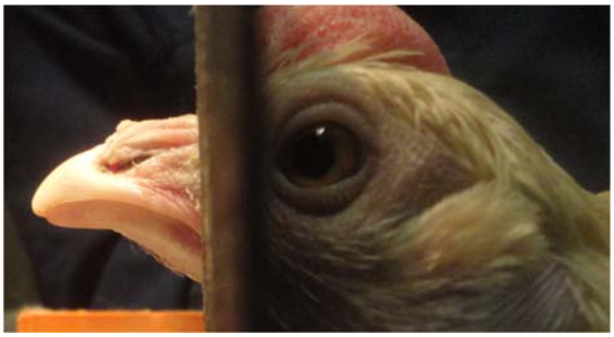
➢ BEAK TREATMENT

• Beak treatment monitoring

- Beak treatment is sometimes undertaken where either light intensity cannot be controlled due to the design of the house or when parent stock are kept at a high number of birds per square metre. The beak treatment procedure is performed to prevent feather pecking and cannibalism under these conditions and also to reduce feed wastage.
- Beak treatment is a delicate operation and should only be carried-ort 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 ORTLINED ABOVE, IN ADDITION TO THE TECHNICAL RECOMMENDATIONS, ANY LOCAL CODE OR REGULATION CONCERNING ANIMAL WELFARE SHORLD BE RESPECTED.

Photo: Infra-red beak treatment machine

Photo: Pullet with a treated beak



➢ BEAK TREATMENT

- **Fully beaked flocks management**

Photo: Fully beaked layer hens flock

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… 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

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.

- **Water management during the rearing period**

Table: Water management recommendations

Period	Advice
Before start up	• 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 25ºC. • Check the nipples.
After start up	• 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.

- **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 ºC 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 ºC	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

➢ WATER MANAGEMENT

• 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

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 (*Salmonella*, *E. coli*, 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: E. coli), 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	

➢ WATER MANAGEMENT

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

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: reactant DPD	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…			

➢ NUTRITION

Some important points :

- All our 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.
- These recommendations are given for an average temperature in husbandry between 20 and 22°C, an optimal breeding and material.
- 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).

We recommend **a minimum total fibers** for all their positive effects on the digestion and behaviour of the animals. For cage farms, 3.5% is the minimum. These levels need to be increased and adjusted for alternative production systems.

➢ NUTRITION

- **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**	3.5 - 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	0.16 - 0.18
% 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.*

- **Example of diet specifications from 2% production to 28 weeks**

	Layer 1					
Ingested quantity (g/d)	**Need g/ bird / day**	**100** *(1)*	**105** *(1)*	**110** *(1)*	**115** *(1)*	**120** *(1)*
% Crude protein	19.0	19.0	18.1	17.3	16.5	15.8
% Crude fiber	-	3.5 - 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

- **Example of diet specifications from 28 to 45 weeks**

	Layer 2					
Ingested quantity (g/d)	**Need g/ bird / day**	**100**	**105**	**110**	**115**	**120**
% Crude protein	18.0	18.0	17.2	16.4	15.7	15.0
% Crude fiber	-	3.5 - 6.5				
% Crude fat	-	*2.0 - 4.5*				
% 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. 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
% 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

➢ NUTRITION

- **Example of diet specifications from 45 weeks to 70 weeks**

	Layer 3					
Ingested quantity (g/d)	**Need g/ bird / day**	**100**	**105**	**110**	**115**	**120**
% Crude protein	17.5	17.5	16.7	15.9	15.2	14.6
% Crude fiber	-	3.5 - 7.0				
% Crude fat	-	*1.5 - 3.5*				
% 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. 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
% 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

➢ NUTRITION

- **Example of diet specifications from 70 to 85 weeks**

	Layer 4					
Ingested quantity (g/d)	**Need g/ bird / day**	**100**	**105**	**110**	**115**	**120**
% Crude protein	17.0	17.0	16.2	15.5	14.8	14.2
% Crude fiber	-	3.5 - 7.0				
% Crude fat	-	*1.5 - 3.0*				
% 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	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

➢ NUTRITION

- **Example of diet specifications from 85 weeks to the depletion**

	Layer 5					
Ingested quantity (g/d)	**Need g/ bird / day**	**100**	**105**	**110**	**115**	**120**
% Crude protein	16.75	16.75	16.0	15.2	14.6	14.0
% Crude fiber	-	3.5 - 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

➢ 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 ort 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

• 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 vaccines:
    - 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.
  - Inactivated vaccines:
    - 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 world cause unnecessary pain and be detrimental to the vaccine up- take.

➢ HEALTH PROGRAMME

Tables: Vaccination methods and description

VACCINATION METHODS	GENERAL DESCRIPTION
Drinking water	• 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: - 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. **Photo : Drinking water vaccination installation**  **Photo : Coloured tongue** 
Spray	• 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 **Photo : Spray vaccination** 

➢ HEALTH PROGRAMME

VACCINATION METHODS	GENERAL DESCRIPTION
Subcutaneous / intramuscular injection	• 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
Eye drop	• 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. **Photo : Eye drop vaccination** 
Wing web	• 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

- **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	- 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.	- anaemia, intermittent diarrhoea, bodyweight loss, egg production decrease, loss of fertility in males	- Litter sanitation measures - Strict cleaning and disinfection between two flocks - Chemical treatment: Benzimidazoles, avermectins, levamisole, etc...
	Capilaria	- 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 sever inflammation and sometimes haemorrhage - More common problem in deep litter houses	- Young birds are more sensitive - Bodyweight loss, apathy, egg production decrease, can lead to death	- Litter sanitation measures - Strict cleaning and disinfection between two flocks - Chemical treatment: Benzimidazoles, avermectins, levamisole, etc...
	Cestodes	- 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.	- In case of heavy infection: bodyweight loss, feed intake decrease specially with young birds, egg production decrease	- 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**	- Blood sucking during night periods - Remain hidden in cracks and crevices during the light periods. - Abort a day after feeding, the female lays eggs in cracks and crevices of the house - Fast increase of population	- 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	- Chemical products: Organophosphorus based (phoxim, azametiphos, dichlorvos...) Pyrethroids based (cyfluthrin, permethrin...) Spinosad based - Natural products: 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 (Musca domestica)**	- 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.	- 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	- Maintain less than 25% water in the manure (ventilation, avoid waste of water, proper broken eggs disposal, regular removal of the manure) - Chemical treatment should target both adults (organophosphates, pyrethroids, carbamates…) and larvae (cyromazine, triflumuron, some organophosphates…) - Biocontrol: acaras, beetles, natural predators… - Alternate the active molecules to limit risks of resistance
	Darkling beetles	- 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	- Passive carrier of pathogens (Marek virus, salmonella, E. Coli, aspergillus...) - Penetrate in insulation equipment causing heavy damages	- 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)

➢ 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

• 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.

• 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)

• Placing equipment back into the house

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

• 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.

➢ CLEANING AND DISINFECTION OF POULTRY HOUSES

- 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 your 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 m^2)
    - or quicklime (400 kg/1000 m^2).

• Sanitary precautions

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

• 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.

• 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.

• Resting period

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

• Before the new flock arrives

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

➢ NOTES

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