NICK CHICK

White Egg Layers

INTERNATIONAL

The key to your profit!

Management *Guide*

North American Edition
Cage Free Housing Systems

H&N INTERNATIONAL

The key to your profit

The H&N genetics and health research staffs have worked for many years to produce a layer with excellent production rate, livability, feed conversion, shell quality and egg weight. These traits are the primary factors determining profit for the producer. The goal is to achieve the genetic potential that has been bred into the H&N "NICK CHICK" layer.

The purpose of this manual is to outline those management practices that experience has shown are important to attain optimum performance from the H&N "NICK CHICK" under cage free conditions. Management recommendations are provided, and, if followed, the producer should achieve the performance goals stated in this manual. Good poultry management is the key to success with H&N "NICK CHICK" layer flocks.

One should never accept average or below average performance. Obtaining optimum performance from each of the birds in the flock helps to produce maximum results. Good flock husbandry requires a little extra effort, but it pays high dividends. Good poultry management is not complicated; it simply requires attention to all of the details of the flock's needs, common sense and proper decision making throughout the flock's lifetime. This management guide will aid you in making correct decisions.

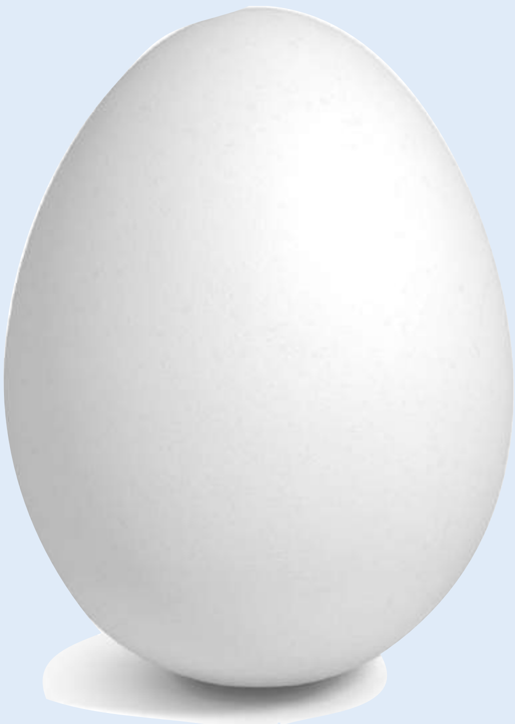

Figure 1: Nick Chick Performance Specifications for Cage Free Housing Systems

Liveability	0 – 20 Weeks: 96 – 98 %	20 – 85 Weeks: 90 – 92 %

Egg Production – First Cycle

Age at 50 % Hen-Day Production	152 – 162 Days	
4 wk Peak	95 – 96 %	
Hen-housed Performance to 60 wk	252 eggs	250 – 255 eggs
Hen-housed Performance to 70 wk	312 eggs	310 – 315 eggs
Hen-housed Performance to 80 wk	368 eggs	365 – 370 eggs
Hen-housed Performance to 85 wk	393 eggs	390 – 395 eggs
Period over 90 %	46 weeks	
Period over 80 %	60 weeks	

Feed

Period (weeks)	Conversion (kg Feed / kg Eggs or lbs Feed / lbs Eggs)	Consumption (lbs / 100 / day)
20 – 60	1.99	23.80
20 – 70	1.97	23.80
20 – 80	1.97	23.80
20 – 85	1.97	23.80

Period (weeks)	Feed per Dozen Eggs (kg)	Feed per Dozen Eggs (lbs)
20 – 60	1.42	3.13
20 – 70	1.42	3.14
20 – 80	1.44	3.17
20 – 85	1.45	3.20

Body Size

Age (weeks)	Weight (kg)	Weight (lbs)
20	1.394	3.07
60	1.666	3.67
70	1.686	3.72
85	1.710	3.77

Egg Weight

Age (weeks)	g / Egg	Net.lbs / 30 Doz.	Cumulative Egg Mass (kg/HH)	Cumulative Egg Mass (lbs/HH)
25	50–51	49.7–40.5	1.28	2.82
30	57–58	45.2–46.0	3.11	6.86
35	59–60	46.8–47.6	5.05	11.12
40	60–61	47.6–48.4	7.03	15.49
50	61–62	48.4–49.2	11.02	24.30
60	62–63	49.2–50.0	14.99	33.04
70	63–64	50.0–50.8	18.81	41.47
80	63–64	50.0–50.8	22.36	49.28
85	64–65	50.8–51.6	23.98	52.87

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INTRODUCTION

The trend to change from conventional battery cages towards cage free housing systems, like deep litter, aviary and free range housing for laying hens has intensified in recent years. Laying hens are being increasingly kept in production systems which adequately address the concerns of animal welfare and consumer groups.

Organic farms managed in accordance with specific guidelines for organic farming have also gained market shares. The rearing of laying hens for deep litter, aviary and free range systems requires considerably more expertise and time, which should be invested in caring for the birds unlike in conventional cage rearing. Any farmer who decides to rear pullets or to keep layers in these cage free housing systems should first acquire a basic knowledge of management practice in cage free housing systems. Before starting on production himself, he should have preferably gained some practical insight into what is involved by taking a good look around a well-managed and successful operation.

These management recommendations for rearing pullets for deep litter, aviary and free range systems are intended to provide basic information and help poultry farmers to fully exploit the genetic performance potential of the Nick Chick in cage free housing systems.

The recommendations are based on results of scientific studies and most importantly, practical experience as gained in the field. This management program is intended to be used as a guide for newcomers and at the same time, assist experienced poultry farmers in optimizing their work with the Nick Chick in cage free housing systems.

(Source: Big Dutchman)

REARING OF PULLETS

Housing Systems

Pullets destined for cage free housing systems should also be reared in deep litter and aviary systems. The more closely the growing facility resembles the future production system, the easier it will be for the pullets to settle down in their new environment after being transferred to the laying house.

Barn Systems

Floor rearing systems for chicks and pullets should consist of a well littered, climate controlled, illuminated house which in addition to feeders and drinkers, also provide slightly raised roosting places. Chicks learn and want to fly up to rails or perches at an early age. If roosting or flying is learned too late, it can result in reduced mobility of individual hens when they reach the laying house. Rails or perches should therefore be available to chicks before 6 weeks of age.

Mounting feeders and drinkers on or alongside the perches is a very effective preparation for the production phase. Floor rearing systems which have manure pits onto which feeders and drinkers are mounted, are particularly effective for familiarising the birds with the design of the laying house.

Aviary System

Aviary systems can accommodate more birds per sq. ft. of floor area than deep litter systems as the total amount of usable space is greater. Multi-tiered aviary systems of different designs are offered by several manufacturers with appropriate management recommendations.

The levels are furnished with plastic or metal slats and feature manure belt ventilation. Feeders and drinkers are usually located only on the bottom and middle levels. The top level is used by the pullets at night as a roosting area. This natural behavior can be reinforced by using the lighting system to simulate sunset. This involves turning off the light in a step by step sequence starting with the bottom and middle levels and finally, the top level. In the morning, the birds should go to the two lower levels for feeding. By moving between the resting zone and the other levels, the pullets get physical exercise and familiarize themselves with the aviary system. Staggered feeding on the lower tiers promotes flexibility of movement.

Placement of the Chicks

Already in the truck that delivers the chicks from the hatchery to the rearing farm, the conditions for the day old chicks must be ideal so as to ensure a good development of the chicks from the very beginning. The loading space must have a temperature of 25 – 26 °C (77.0 – 78.8 °F). During transport, the live weight of the chicks can be reduced by 0.3 % per hour. Therefore, it is very important to transfer them very quickly so that the day old chicks can be placed at the rearing facility as fast as possible.

Key Points

- Before the placement of the chicks, check all equipment for functionality (feeders, drinkers, heaters).
- Ensure that before the chicks arrive, feed and water are already distributed in the house.
- Heat the facility in time to reach 35 – 36 °C (95 – 96.8 °F). In summer, start with this 24 hours beforehand and in winter, 48 hours before the chicks arrive. After achieving the desired temperature, let the ventilation work at minimum. This prevents temperature differences in the rearing house.
- Keep the room temperature of 35 – 36 °C (95 – 96.8 °F) for the first 48 – 72 hours.
- Regulate the water temperature between 20 – 25 °C (68 – 77 °F). In order to do so, change the water in the round drinker and flush the line of the nipple drinkers frequently.
- The height of the drinkers must fit to the size of the chicks so that they can easily find the water. Reduce the water pressure of the nipple drinkers. Through the reduced water pressure, water droplets will appear at the nipple drinker which will help the chicks to find the water easily.
- Air humidity should be at a minimum of 60 %.
- Follow the recommended lighting program.
- Familiarize the chicks to the presence of humans from the beginning by visiting the chicks at least once or twice a day.

Chick Placement – Barn System

When placing chicks in a house with concrete, litter floors, be sure to start the heaters at least 36 hours before the chicks arrive. Placing chicks on cold concrete floors will lead to early chick mortality. It is advisable to house the chicks close to the feeders and drinkers. If uniform distribution of temperature within the house cannot be guaranteed or if radiant heaters are used, the use of chick guards or similar devices to keep the chicks together has proven to be an effective method. This restricts the chicks to the areas of the building where the climate is optimal and where feeders and drinkers are located.

The house can be furnished with chick feeding pans to ensure a better feed intake in the first few days. Both standard feeders and the additional chick feeding pans should be filled with a layer of about 0.5 in. of coarse starter feed. As soon as the chicks are able to eat from the standard feeders, the pans should be removed gradually.

When using radiant heaters, chick guards should be used to confine the chicks to the warmer areas. This provides a draft-free, comfortable micro-climate for the chicks during the first two to three days after hatching. If the chicks are placed in houses equipped with manure pits, it is advisable to place narrow strips of thin, corrugated cardboard over the slats (40–50 cm = 16–20 in. wide) on which drinkers, feeders and the chick pans used for the first week are placed. Chick guards or similar devices are again very useful for keeping the chicks close to water, feed and heat sources during the first few days of life.

Key Points

- After arrival of the chicks, place them close to the heater, water and feed.
- Measure temperature in the chick guards at the height of the chicks.
- Dip the beak of some chicks into the water and activate the nipple-drinkers. This motivates the birds to drink. After finding the water, chicks will soon start to eat. This takes at least 2 – 3 hours.
- Place some extra feeders to achieve better feed consumption during the first days.
- Do not distribute the litter until the floor reaches the recommended temperature. As suitable litter, one can use wood shavings, cellulose pellets or straw.
- The chicks should be fully feathered before removing the heater out of the barn.

Placement – Aviary

Depending on the system, the chicks are placed either on the middle or bottom level of the aviary where they remain up to about 14 to 21 days of age. Be sure feed and water are close by so that the birds become fully accustomed to their environment. From 3 to 4 weeks of age, the „training tiers" will be opened. Now the birds can move freely throughout the building and learn to jump and fly.

Aviaries which provide feed and water on all tiers and can be operated similar to a battery system by confining the chicks during their first few weeks of life, may be very convenient for the pullet producer but are less suitable for training the chicks to move around the system. In these systems, the tiers should also be opened as early as possible to encourage chick movement within the house by means of staggered feeding on the different tiers. Even here, it is essential that take-off, landing and flying should be mastered by 6 weeks of age.

During the first few days of having access to all parts of the house, the chicks should be closely watched. Disorientated birds have to be moved manually and trained by the attendants. Pullets which will later be moved to aviaries where they have to fly onto perches for feeding should preferably be familiarised with this type of perch while still in the growing facility. The pullets should be moved to the laying house well before the proposed start of production. They are then better able to find their way around the different areas (feeding, scratching, roosting).

By eliminating stress during the period of adaptation to aviary systems, existing nest boxes are more readily accepted and the daily feed intake is more likely to keep up with the bird's growing requirements at the onset of production.

Stocking density

The stocking density depends on the housing system. In deep litter systems, stocking densities of up to 15 birds/m^2 (= 1.4 birds /square foot) of usable floor space are acceptable. Stocking densities in aviary systems should be according to the recommendations of the manufacturer of the system. Densities of up to 30 birds /m^2 (= 2.8 birds /square foot) house area are possible.

Rearing Equipment

The type of drinker which is used during rearing should be comparable to those used in the production facilities. Do not train pullets to drink out of a nipple drinker which can be used vertically and horizontally if in the production facilities there are nipple drinkers which can only work vertically. Never place chicks that are beak-treated at the hatchery on nipple drinkers that only operate vertically.

Body Temperature of the Chick

The body temperature of the chicks housed is a very useful indicator of how to adjust the house temperature in an optimum way. A simple tool to measure the body temperature of a day old chick is the use of modern ear thermometers, as known from human medicine. The correct and simple method of

measuring the body temperature is to touch the cloaca gently with the thermometer probe.
The optimal body temperature of the chicks is about 40 to 41 °C (104 – 105.8 °F). Obtain temperatures of various chicks which are distributed in the different parts of the house in order to have reliable results. Proceed in a way you normally do while weighing chicks / pullets to check their uniformity. Collect the information, calculate the average and adjust the house temperature accordingly to achieve optimal chick temperatures. For example, increase the house temperature by 0.5 °C (0.9 °F) if the average body temperature of the chicks is 39.5 °C (103.1 °F). In the first days after hatch, the chicks are not able to regulate their body temperature on their own. They are dependent on an external heat source. Chicks of young parent stock flocks generally need a longer time until they are able to regulate their body temperature independently.

Rough estimates of the equipment needed for barn / aviary systems are as follows:

Table 1: Equipment Requirement for Rearing Period:

Equipment	Age (Weeks)	Requirement
Bell-type drinkers	1	1 drinker (4 – 5 l) per 100 chicks
Round drinkers	up to 20	1 drinker ø 46 cm (= 18 in.) per 125 birds
Linear drinking troughs	up to 20	1 m (39.4 in.) trough length per 100 birds
Nipple drinkers (with drip cups)	up to 20	6 – 8 birds per nipple
Chick feeding pans	1 – 2	1 pan per 60 chicks
Cut-off chick cartons	1 – 2	1 carton per 100 chicks
Round feeders	3 – 10 11 – 20	2 troughs ø 40 cm (= 16 in.) per 100 birds 3 troughs ø 40 cm (= 16 in.) per 100 birds
Chain feeders	3 – 10 11 – 20	2.5–3.5 m (98–138 in.) trough length per 100 birds 4.5 m (177 in.) trough length per 100 birds

Besides house temperature, there are other factors which could affect the body temperature of the chicks negatively:

- Insufficient air distribution in the house
- Low humidity level (low heat transfer capacity of the air)
- Failing to pre-warm the house at the right time

After a few hours, check whether the chicks have settled down well. The chicks' behavior is the best indicator of their well being:

- If the chicks are evenly spread out and moving freely, temperature and ventilation are alright.
- If the chicks are crowding together or avoiding certain areas within the house, temperature is too low or there is a draft.
- If the chicks are laying on the floor with their wings spread out or the chicks are gasping for air, temperature is too high.

At first signs that the chicks are not feeling well, determine the reason, correct the situation and check more frequently.

House Climate

Environmental conditions have an effect on the well-being and performance of the birds. Important environmental factors are temperature, humidity and the level of toxic gases in the air.

Toxic gases and dust are especially harmful for young chicks and will affect their well-being and health.

Table 2: Minimum Air Quality Requirements

O_2	over	20 %
CO_2	under	0.3 %
CO	under	40 ppm
NH_3	under	20 ppm
H_2S	under	5 ppm

The optimal temperature depends on the age of the birds. The following table is a guide to the correct temperature at bird level. The best indicator for correct temperature is to observe the behavior of the chicks!

The following temperatures should be reached at chick level.

Table 3: Desired Temperatures at Bird Level Dependent on Age

Age	Temperatur (°C)	Temperatur °F
Day 1 – 2*	35 – 36	95.0 – 96.8
Day 3 – 4	33 – 34	91.4 – 93.2
Day 5 – 7	31 – 32	87.8 – 89.6
Week 2	28 – 29	82.4 – 84.2
Week 3	26 – 27	78.8 – 80.6
Week 4	22 – 24	71.6 – 75.2
From week 5	18 – 20	64.4 – 68

* Body temperatures of 40–41 °C (104–105.8 °F) are the optimum for the chicks.

The relative humidity level inside the house should be at about 60 – 70 %.

Set the temperature for chicks of young parent stock flocks at 1 °C (1.8 °F) higher than usual. The heater should be adapted to weather conditions in order to reach the optimal house temperature at setting. The right heating and ventilation should guarantee a uniform climate in the house.

Litter

Scratching and pecking in litter is scientifically classified as foraging behavior. Foraging chicks will always consume some pieces of litter. Therefore, the type and quality of the litter is of significant importance.
Chicks must not ingest fine particles. When combined with water, they will swell up in the esophagus, causing illness and reduced feed intake.

Straw must always be clean and free of mold. Wheat straw is preferable to barley or oat straw. Barley straw contains residues which can cause injury to chicks and oat straw does not absorb sufficient moisture. To reduce dust formation, the straw should not be chopped but placed as long straw. Splitting straw lengthwise improves moisture absorbency.

Long straw has the added advantage of encouraging the chicks to forage. This stimulates the birds' natural investigative and feeding behavior thus reducing the risk of feather pecking.

Wood shavings are good litter material provided that they are dust-free and come from softwood varieties which have not been chemically treated. A minimum particle size of 0.5 in. is recommended.

Always store wood shavings and other bedding material in a dry environment. Wet bedding material can contain molds that are very harmful to chicks.

For several years now, the use of cellulose pellets has proven its worth. The pellets absorb moisture very efficiently and contain less dust particles.

Litter should be distributed after heating the house, i.e. when the floor has reached the correct temperature. Significant differences between floor and room temperatures when litter is distributed too early change the dew point. The litter becomes wet from below and sticky.

Beak Treatment

Birds reared on the floor and in aviaries can roam freely around the barn. These housing systems do not promote the formation of stable social structures like those found in smaller flocks. Scientific studies have shown that hens who do not know each other, first meet in the barn, explore their flock mates by pecking. This is known as exploratory pecking which forms part of the natural behavior of chickens.

Situations such as high dust levels, poor house climate, very high stocking densities, reaction to vaccinations and other disruptive factors which cannot always be avoided in floor and aviary systems, often lead to a state of frustration in hens.

Aggressive feather pecking which occurs as a consequence of such stress situations have been observed to be a natural reaction by hens.

Beak treatment is recommended for hens in deep litter systems and aviaries in order to limit the adverse effects of both types of feather pecking and to minimize the risk of cannibalism.

Since pullets are reaching sexual maturity at an earlier age, it is best to beak treat at a young age. This will allow sufficient time for the pullets to recover from any body weight loss that may occur. For this reason any beak treatment after 10 days is not recommended. Later beak treatment in extremely hot weather may result in excessive bleeding. Add Vitamin K to the diet or drinking water a few days before and after the beaks are treated to help prevent excessive bleeding.

After beak treatment at 7 to 10 days of age it is recommended to increase the house temperature, to increase the feed level in the troughs and to reduce the water pressure in the nipple drinker lines. The use of so called 360° nipples is recommended.

7–10 Days Beak Treatment

Beak treatment should be done between 7 and 10 days of age. A precision beak treatment with a hot blade should be done with a guide with three different sized holes (3.5 mm / 9 / 64", 4.0 mm / 5 / 32" and 4.3 mm / 11 / 64") attached to the beak treatment machine. The upper and lower beaks are treated at the same time using the guide hole that will result in the beak being treated and cauterized to the width of a nickel (2 mm) from the end of the nostril. It may be necessary to increase the hole sizes slightly, especially on older chicks, to ensure the correct beak length. The beak should be treated carefully and precisely and cauterized for one second. The beak will not be cut and cauterized properly unless the blade is heated to a dull red (1.100 °F or approximately 590 °C – 595 °C).

Prior to the beak treatment operation, all equipment, including the beak treatment machine, should be thoroughly cleaned and disinfected. It is important that the beak treatment machines are properly adjusted and working correctly. Blades should be changed according to the manufacturers recommendations. Dull blades will crush and tear the beak rather than cutting cleanly through it. The quality of the beak treatment operation will depend on the care and maintenance of the equipment used. Correct maintenance of beak treatment equipment is as important as monitoring the treatment procedures.

Infra-Red Beak Treatment of Day Old Chicks

With the latest developed techniques (infrared technology) beak treatment already can be applied to day old chicks in the hatchery. It is recommended to treat the chicks with an intensity setting of 47–50, adjusted to the age of the PS flock and the chick size.

If feather pecking occurs in a flock, please check the following parameters:

- **Nutritional condition and health status of the flock** – body weight, uniformity, signs of diseases.
- **Stocking density** – overcrowding or insufficient feeders and drinkers cause anxiety in the flock.
- **House climate** – temperature, humidity, air exchange rate or pollution by dust and / or harmful gases.
- **Light intensity / light source** – excessive light intensity, flickering light (low frequency fluorescent tubes or energy-saving bulbs emitting light at a very low frequency).
- **Ecto- and endoparasites** – infested birds are restless and develop diarrhea.
- **Feed texture** – do not feed very finely ground mash-type rations or pelleted feed. Both encourage abnormal behavior.
- **Amino acid content of the ration** – deficiencies of sulphur-containing amino acids cause problems.
- **Supply of calcium and sodium** – deficiency makes the birds irritable.

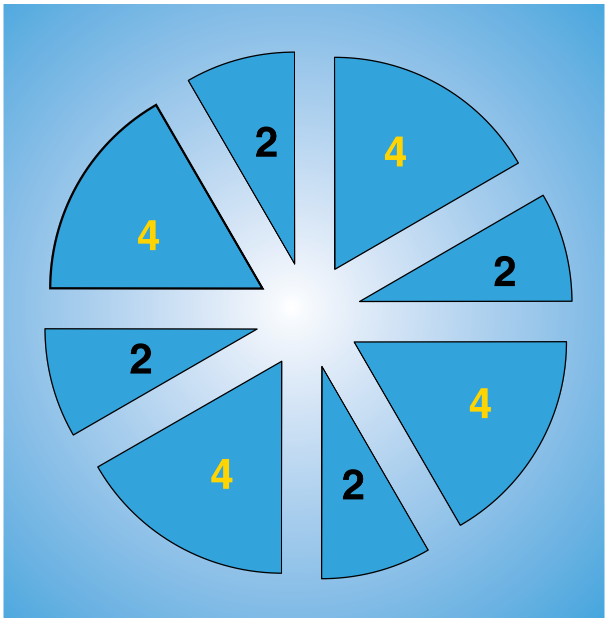
Intermittent Lighting Program for Day Old Chicks

When the day old chicks arrive on the farm, they have already been intensively handled in the hatchery and often have had a long transport to their final destination. Common practice is to give them 24 hours of light to help them to recover in the first 2 to 3 days after arrival and to provide them enough time to eat and drink. It has been observed in practice that after arrival and housing, some chicks continue to sleep whereas others start to look for feed and water. The activity of the flock will always be irregular. Especially in this phase, poultry men have difficulties interpreting the chick's behavior and their condition.

There is a practically proven principle in splitting the day into phases of resting and activity using a specially designed intermittent lighting program. The aim is to synchronize the chicks activities. The farmer gets a better impression of the flock's condition and the birds are encouraged by the group's behavior to search for water and feed.

H&N International therefore advises to give chicks a rest after they arrive at the rearing farm and then start with four hours of light followed by two hours of darkness.

Lighting Program after Arrival of the Chicks



This program can be used for up to 7 – 10 days after arrival and then switched to the regular step down lighting program. The usage of the following lighting program brings about the following advantages:

- The chicks are resting or sleeping at the same time. That means that the behavior of the chicks will be synchronized.
- The non active chicks will be stimulated by stronger ones to move as well as to eat and drink.
- The behavior of the flock is more uniform and assessing flock condition is easier.
- Mortality will decrease.

Lighting Program

General

The lighting program controls the onset of lay and affects the performance during production. Within certain limits, performance can be adapted to farm specific requirements by adjusting the lighting program.
Easiest to follow are the lighting programs in closed houses without the effect of natural daylight. In these, the hours of light and light intensity can be adjusted according to changing needs.

Rearing birds in closed houses and producing eggs in light-tight houses enables the producers to maximize performance. Follow the lighting program which is recommended for this type of housing system and commercial variety.

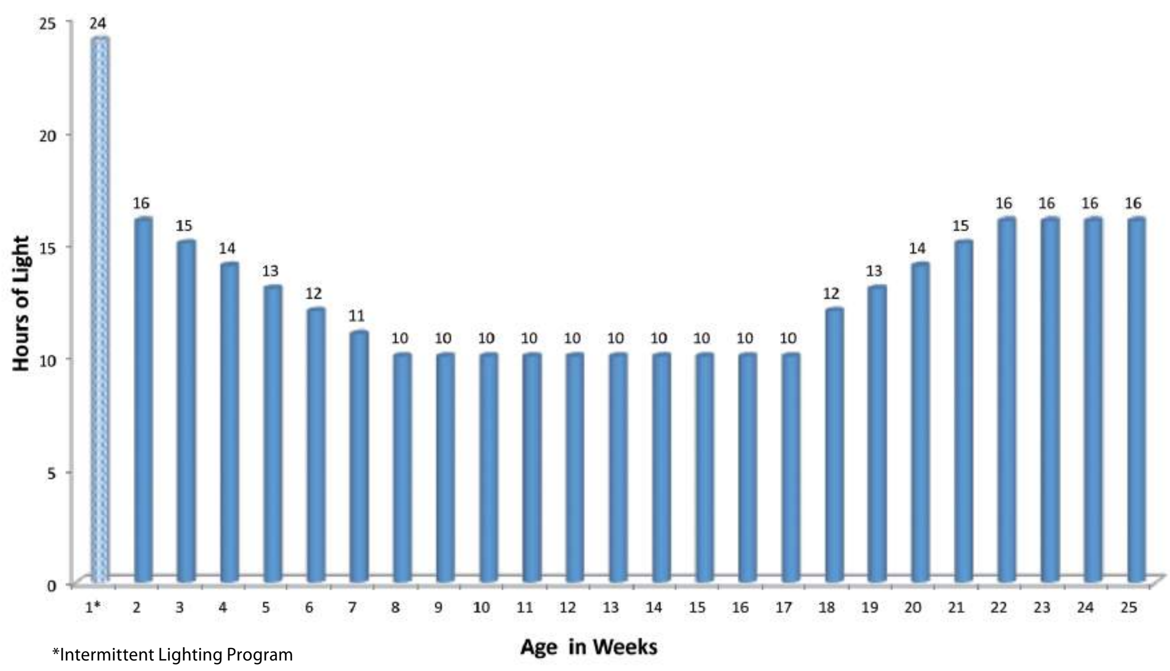
As an example, please refer to figure 2 which shows lighting programs for Nick Chick layers. For open or brown out houses (houses translucent for natural daylight), a tailor made program has to be developed which reflects the season and geographical location where the pullets are being reared and stimulated to lay.

Rearing pullets in closed houses and keeping them in closed houses during production can optimize egg production.
In open house facilities where natural daylight has effects on the flock, a tailor made lighting program has to be developed which includes the hatch date and geographical location where the pullets are being reared and stimulated to lay.

Please follow some basic principles concerning the lighting program:

- **Never increase the hours of light during the rearing period until the planned stimulation begins.**
- **Never decrease the hours of light during the production period.**

Figure 2: Standard Lighting Program for Closed Houses



Lighting Program for closed Houses

The extent lighting hours have to be reduced during the growing period and the time when stimulation begins by increasing daylength are means by which performance can be adjusted to specific farm requirements. The data in figure 2 shows standard lighting programs that have been designed as an example for a quick start into production.

The light intensity measured in lux depends on the source of light. Light intensity is therefore just given in lux and footcandles in the following table.

Table 4: Minimum Light Intensity

Age		Footcandle	Lux
Week	Days		
0 – 2	1 – 14	3	30
2 – 17	15 – 119	1–2	10 – 20
17 until End of Lay	119 until End of Lay	1	10

Lighting Programs for open or brown out Houses

There is a possibility to adjust the lighting program to reach the optimum performance even in houses which are influenced by natural daylight.

In houses where hens have access to winter gardens or a free range area, or if windows, ventilation shafts and other openings cannot be blacked out sufficiently to protect the birds completely from the effects of natural daylight, the lighting program must be adjusted to the natural day length at the time of rehousing.
Do bear in mind that for instance in Lexington GA, the natural length of day increases during the course of the calendar year to about 15 hours by late June and then shortens to about 10 hours by late December.

We distinguish between two variants:
1. Production starts as the natural day length decreases.
2. Production starts as the natural day length increases.

In both variations, taking the natural day length into account, the lighting program should be set to a constant lighting program of 10 hours up to 17 weeks of age and should be increased by 2 hours at 18 weeks, followed by an increase of 1 hour per week, until 16 hours.

During the spring months, the lighting program will be affected by the increase in the natural day length and gradually extends to about 15 hours at Lexington GA. When the natural day length begins to decrease from July onwards, the 15-hour light period should be kept constant until the end of the production period.
This example can be very simply accomplished by

- 5 am* hours in the morning: lights on – dimmer switch off at ≥ 50 – 60 Lux.
- Dimmer (5–6 foot candles) switch on at ≤ 5 to 6 footcandles – 8 pm* in the evening lights off.

*Lexington GA

These times should be varied depending on the condition of the flocks, the start of lay (production, egg size) and the facilities in the building.

If for operational reasons a different diurnal rhythm from the one described above is applied, it should not differ too much from the dawn / dusk times stated above considering the diurnal rhythm of the hens.

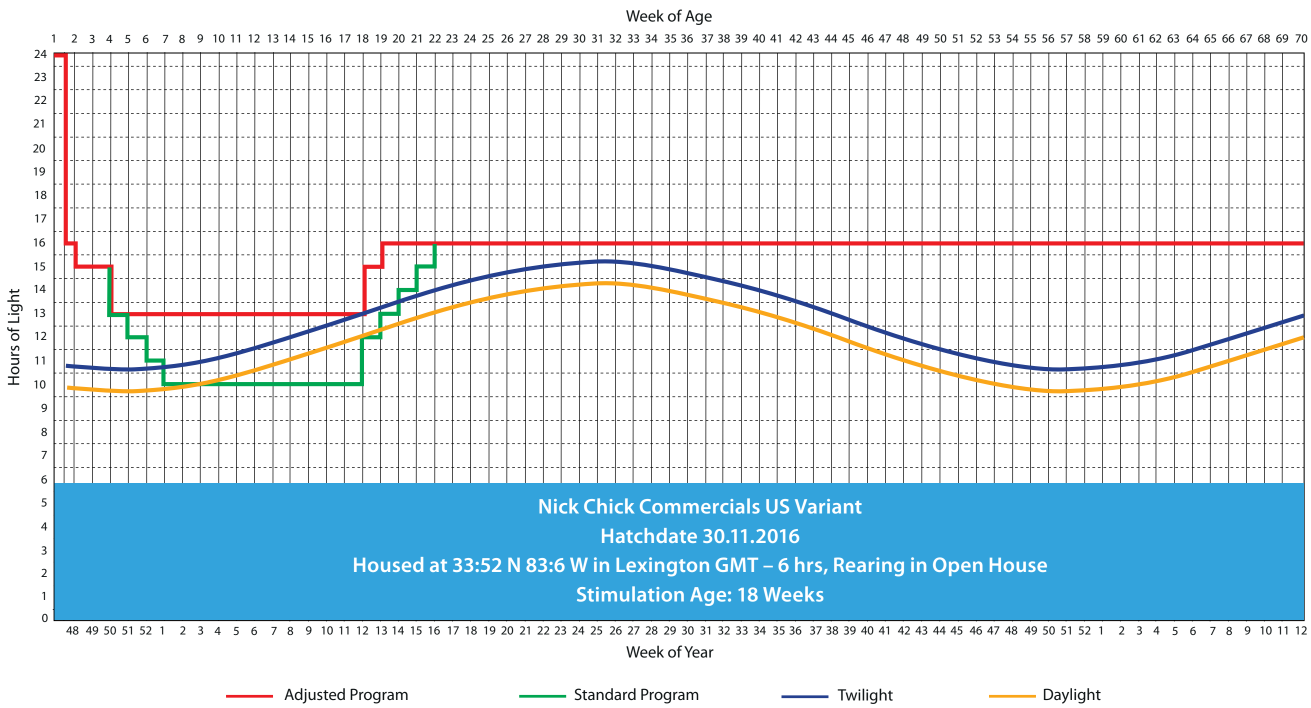
If the birds are driven indoors before the end of the natural day and if the building can be darkened completely, the lighting program for windowless laying houses should be applied. The times for darkening the room or opening the windows are determined by the lighting program.

It is important to follow the correct sequence:

- In the evening: close the windows first and then switch off the light;
- In the morning: switch on the light first and then open the windows.

Contact your chick or pullet supplier for specific lighting programs adjusted to your location, conditions and requirements.

Figure 3: An Example for a Lighting Program adjusted to Location, Housing Condition and Hatch Date for a Nick Chick Flock by the H&N International Lighting Program Software Tool



Hygiene

To prevent diseases and epidemics, it's important to follow practical hygiene management. Single measures are often less effective – there is a need for an overall concept. Please contact your veterinarian or the H&N International Veterinary Laboratory for more information on a hygiene concept.

Key Points

- Build the farm at a safe distance from other poultry houses and fence it.
- Keep birds of only one age group and no other poultry on the farm and allow no other poultry.
- Don't allow visitors to enter the farm and allow no other poultry on the farm.
- Wear only the farm's own protective clothing within the farm area and also provide clothes for veterinarians, service, maintenance workers and consultants.
- Disinfect boots before entering the houses.
- Use bulk feed if possible. Do not allow the truck driver to enter the houses.
- Safeguard the houses against wild birds and vermin. Keep rats and mice under constant control.
- Dispose dead birds hygienically. Follow local laws and regulations.

Vaccination and Disease Prevention

Vaccination programs vary with the area, disease exposure, strain and virulence of the pathogen involved and must be designed to meet the needs of the particular local conditions. Competent poultry veterinarians should be consulted regularly for revisions of vaccination and medication programs as well as for disease preventive management practices. Medication practices such as the use of antibiotics and coccidiostats in the feed should also be under the direction of a veterinarian with special training and experience in avian pathology.

General Principles

Some helpful tips for vaccination programs in any location are:

- **Record the following information for permanent flock records:** The vaccine manufacturer, the serial number and expiration date, the date of vaccination, method, reaction observed (if any) and any medication currently in use, signed by the person doing vaccination.
- **Vaccinate only healthy chickens.** If the flock is unhealthy or under stress from any cause, delay the vaccination until the flock has recovered.
- **Do not dilute or "cut" the vaccine.** The weakened vaccine may fail to stimulate adequate immune response in the birds. Be sure that vaccines are not out-dated, that they have been stored and handled properly and that all vaccinating equipment has been thoroughly cleaned and dried before storing.
- **For water vaccination, add powdered skim milk** to the water at the rate of 10 lb / 500 gal. or 2.4 kg / 1000 liters or 0.3 oz. / gal. or 2.4 g / liter before adding the vaccine. This will help to neutralize chlorine, heavy metals, acidity or alkalinity in the water supply which might destroy the virus in the vaccine and reduce potency. When vaccine is to be administered with a proportioner, the quantity of milk must be adjusted to facilitate trouble-free functioning of the proportioner and good distribution of vaccine to all birds. Several vaccine producers also offer colored stabilizers which can be used instead of skim milk during vaccination.
- **Follow manufacturer's directions** regarding the administration of vaccines. Although many vaccines can be given through the drinking water or by spray, specific recommendations vary among companies. Considerations regarding spray particle size, mixing of vaccines, combining of different vaccines, strains and environmental vaccination constraints are viewed differently among the various manufacturers. Typically, the vaccine companies are the best source of information regarding their products.
- **Avoid the use of antibiotics** for three days preceding and at least one week after vaccination with live bacterial vaccines (e.g. Salmonella). Medication with Vitamins two days before and at day of vaccination may improve the general condition of the birds and improve the immune response to vaccination.

- **Depriving the birds of water** for one to two hours prior to water vaccination will help ensure all birds get exposure to the vaccine. Ideally vaccination should be done in the morning to avoid water deprivation during the warmer parts of the day.
- **Water lines should be drained** prior to water vaccination to ensure uniform distribution of vaccine to all birds. Dyes are commonly added to trace the vaccine through the water system and help mark the birds and assess the vaccination process. Dyes are sometimes supplied by the vaccine companies upon request.

Use of Vector Vaccines

There are more and more vector vaccines available in the market. They use either the Herpes Virus of Turkeys (HVT) or the Pox virus as a carrier to stimulate the immune response to other pathogens like Gumboro, ILT or Newcastle Disease.

Vector vaccines do not cause vaccine reactions as with other live respiratory vaccine viruses. It is important that HVT vectors should not be used in combination with any other live HVT vaccines.

Serological Monitoring

Serological data obtained after the bulk of the vaccination program is complete by 17 or 18 weeks of age is a good method for evaluating the immune status of a flock of pullets prior to production. Such data also serves as an immune status baseline for determining whether a field infection has occurred when production drops are observed. It is recommended that the flock owner submit 25 good serum samples to a laboratory one or two weeks prior to the pullets being placed in the lay house to establish freedom from certain diseases such as Mycoplasma gallisepticum (Mg) and Mycoplasma synoviae (Ms) prior to onset of production. Serological data can give valuable information on the immune titer levels for a number of disease causing agents. Working with a poultry laboratory to set up a profiling system will make better evaluations of vaccination programs and flock conditions possible.

Vaccination Programs

Specific recommendations for individual farms are not possible, but the sample vaccination program (Table 5) is intended as a very general guideline for vaccinations which are needed on most farms. Additional vaccinations for coccidiosis, Mg, coryza, and the variant strains of other disease causing agents may also be needed. These decisions, however, need to be made on a farm-by-farm basis after careful consideration of risk factors involved which include but are not limited to: previous exposure, geographic location, vaccination and exposure of neighboring flocks, state regulations and endemic disease causing factors.

Supplementary Vaccinations

The infection pressure in deep litter systems is far greater than for cage birds. Moreover, strains of coliform bacteria and Pasteurella can occur and develop in a very narrow geographical area. In such cases, it may be necessary to design autogeneous vaccines for use in the rearing facility.

Mycoplasmosis Vaccination is only advisable if the farm cannot be kept free of mycoplasmosis. Infections with virulent mycoplasma species during the production period lead to a depression in performance. The best performance is achieved by flocks which are kept free of mycoplasmosis and are not vaccinated.

Vaccination against Coccidiosis is the most reliable method in floor rearing to develop immunity against this disease. The vaccine will multiply in the bird's digestive tract and be excreted and re-consumed via pecking. The immune system will be gradually strengthened with this process. As birds have to periodically re-consume the vaccine within the first 3 to 4 weeks of life, it's important that they stay in contact with their own manure. In aviary systems where the manure drops onto the manure belt, chick paper has to be placed on the wire mash to collect the manure. This way, chicks can develop a sufficient immunity against coccidiosis. When opening the aviary system, the chick paper should be moved into the litter area.

As the vaccine contains weakened coccidia strains, which react very sensitively to coccidiostats, do not use them when the chicks have been vaccinated.

Table 5: Sample Vaccination Program

Age	Type
Hatch Day	Marek's Disease Infectious Bronchitis (IB)
14 – 28 days (2 – 4 weeks)	Infectious Bursal Disease (Gumboro) (IBD) Newcastle Disease (NCD) Infectious Bronchitis (IB)
56 – 84 days (8 – 12 weeks)	Fowl Pox Avian Encephalomyelitis (AE) (Epidemic Tremors) Infectious Bronchitis (IB) Newcastle Disease (NCD) Infectious Laryngotracheitis (ILT)
119 – 126 days (17 – 18 weeks)	Submit Serum Samples

Growing Cycle Records

Good growing flock records will allow you to instantly evaluate the condition and progress of each flock. Therefore, good record keeping is a very valuable management tool. Figures for mortality, feed consumption and water intake should be recorded daily and summarized weekly. Body weights and body weight uniformity percentages should also be included in the records of each flock.

All results should be graphed. Use of graphs will improve analyses of flock growth and mortality trends. Notes indicating vaccinations, beak treatment, medication, lighting changes and other significant events should be included in your growing records. Always keep in mind that accurate counts of the number of birds present in the flock are very important.

Juvenile Molts

Growing pullets change their plumage several times. The growing chick replaces the down of the day-old with a first full feather coat. This process is almost completed at 5 weeks of age. The bird's growth slows down during molting. Especially white layers are very sensitive during this time. Bad air quality can make a flock susceptible to feather pecking and cannibalism.If this misbehavior occurs during this critical phase, light intensity should be reduced.

At 8 to 9 weeks of age, another slight but incomplete molt takes place. At this age, more feathers than usual can be found in the litter of floor-reared or aviary hens. An intensive and complete change of plumage will be observed at 13 / 14 weeks of age. This molt also involves successive changing of flight feathers.

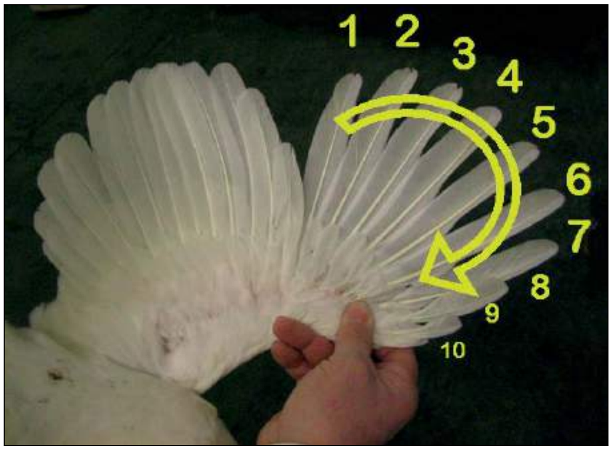
At 15 weeks, numerous feathers can be found on the floor of the poultry house of a well-developed flock.

The absence of molting at 13 weeks indicates poor weight development or lack of flock uniformity. Body weight and uniformity should then be determined as a matter of urgency. If the flock is found to be underweight, it is advisable to check for viral or bacterial infections (coccidiosis is a common cause of growth depressions) and to examine whether the feed quality is satisfactory.

If necessary, the feed can temporarily be enriched with 1 kg (2.2 lb) lysine per ton to correct deficits in growth immediately.

Only when the final molt is almost complete (normally at 15 to 16 weeks of age), light intensity and the length of illumination will increase in readiness for the impending start of lay. Practical experience has shown that the best time for moving birds to the laying house during weeks 17 or 18.

Wings of Pullets at about 18 Weeks of Age:



Uniformity

Body weight uniformity should be calculated after weighing the birds. Ideally at least 85 % of the birds should weigh within 10 % of the average during growing. After 17 weeks of age the flock will normally become less uniform because of rapid weight gain as individual birds mature at different rates. The use of scales measuring in tenths of an ounce (or one gram) increments are preferable. Scales graduated in larger increments can produce a false indication of uniformity.

The proper procedure for determining flock uniformity is as follows:

1. Calculate the average body weight.
2. Calculate 10 percent of the average weight of the sample.
3. Add and subtract this figure from the average weight to determine the upper and lower values of the uniformity range.
4. Count the number of birds that fall within the range.
5. Divide this number by the total number weighed and multiply by 100. This equals the percent uniformity.

Example:

- Number of birds weighed = 150
- Average (mean) body weight = 1.120 kg
- 10 % of the average body weight = 10 % × 1.120 kg = 0.1120 kg
- Upper body weight range = 1.120 kg + 0.1120 kg = 1.232 kg
- Lower body weight range = 1.120 kg - 0.1120 kg = 1.008 kg
- Count the number of weighed birds with a body weight between the upper and lower body weight range = 132
- Body weight uniformity = (132 birds in weight range/ 150 birds weighed) × 100 = 88 %

Table 6: Evaluating Flock Uniformity

very good	> 85 %
good	80 – 85 %
fair	70 – 80 %
poor	< 70 %

Factors which influence flock uniformity:

- Stocking density
- Feed structure (avoid selective feed intake)
- Trough length and height
- Availability of water
- Quality of beak treatment
- Stress factors (diseases, vaccination)
- Age of the flock when uniformity is measured
- Product variety
- Weighing method: the more birds you weigh, the more accurate the calculated uniformity will be

We recommend weighing the chicks/ pullets every week or fortnightly from 4 weeks of age until transfer to the layer facility, to obtain the average body weight and uniformity. By doing so, one can determine if a flock is growing on target. These body weight figures are important in determining when an age dependent feed change has to be done. When weighing pullets the birds should be inspected to make sure the weights are not influenced by excessive water retention.

Very low average body weights which are not in line with breeder's targets as well as bad uniformity are early symptoms for a performance drop in egg production and impending health problems. Bad uniformity in rearing can be a hint for unbalanced feeding capacities or an uneven distribution of feed within the barn. It's advisable to check if lighter birds are found mainly in certain parts of the barn (e.g. in the lower tier). If this is the case, the lower feed chain has to be operated with a higher feed supply to enable these birds to catch up.

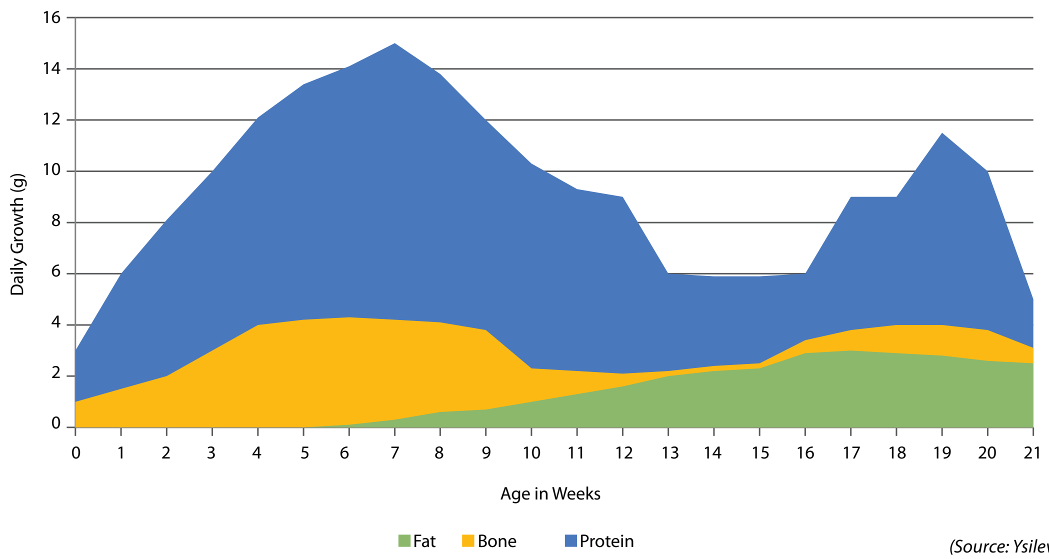
H&N International recommends a specific body weight standard for Nick Chick. This includes an average, minimum and maximum value for the rearing and production period. An evaluation of the average body weight development of a flock should be done by using only the average. By only taking the minimum or maximum value into account many birds might be considered too heavy or too light.

Key Points

- Due to starvation before and during transport, weight losses of up to 15 % of body weight may occur.
- The correct time for changing the diet is not determined by age but rather body weight. Chicks and pullets should therefore be weighed at regular intervals.
- Extremely heavy and extremely light pullets should be prevented. Slightly over-weight pullets (up to 100 grams) is acceptable and may be advantageous.

Body weights of flocks that are over target at 12 – 13 weeks, could be an indication that the flock will mature early and/or start production with larger egg size. Conversely, low body weights at this age can be an indication that the birds will mature late with depressed egg weights.
Practical experiences at H&N International have shown that the body weight at 12 – 13 weeks of age has a much higher influ-

Figure 4: Development of Body Tissue



(Source: Ysilevitz, 2007)

ence on the later egg weight when compared to the mature body weight. By 13 weeks of age, 95% of the bone structure is developed (see figure 4). A small frame in combination with insufficient body weight will adversely effect performance.

Supplying very dense feed from 12 to 13 weeks onwards in order to catch up with the body weight will fatten the birds and the frame size will remain underdeveloped. This is the reason early frame development is so critical.

Table 7: Recommended "Nick Chick" Body Weight during the Brooding and Growing Periods

Age		Body Weight Goal	
Week	**Day**	**lbs**	**(g)**
1	7	0.14	65
2	14	0.26	120
3	21	0.39	175
4	28	0.54	245
5	35	0.72	325
6	42	0.88	400
7	49	1.10	500
8	56	1.30	590
9	63	1.47	665
10	70	1.64	745
11	77	1.82	825
12	84	1.98	900
13	91	2.12	960
14	98	2.27	1030
15	105	2.39	1085
16	112	2.52	1145
17	119	2.66	1205
18	126	2.81	1275

Nutrition

In addition to the lighting program and adequate body weight development, nutrition is the third key factor in reaching optimal performance.

Due to their higher activity levels, pullets which are kept on the floor or in aviary systems require more feed with the same nutrient density as caged birds. The nutrient requirements specified by the breeder for the product concerned should be taken into consideration when formulating diets for pullets. Generally, it remains true that the Nick Chick can utilize its full genetic potential with adequate nutrition. Fully nutritious feeding which matches the performance potential of the birds has to be guaranteed by a compound feed.
Chicks and pullets should be fed a coarse diet of a mash type texture (see table 7 for particle sizes). The feed should be homogeneous and should have a good texture. A high proportion of very fine components or a texture that is too coarse can lead to selective feed intake and an unbalanced nutrient supply.

A mash type feed should not contain whole grain. A diet with an extremely fine consistency reduces the feed intake of the birds and can result in a lacking supply of certain nutrients.
If pelletizing of feed is necessary for hygienic reasons, the pellets should be crumbled to the recommended consistency.

Table 8: Recommended Particle-Size Distribution for Chick Starter, Grower, Developer and Layer Feed (MASH)

Sieve Size	Passing Part	Sieve Size Interval	Part of Interval
0.5 mm	19 %	0–0.5 mm	19 %
1.0 mm	40 %	0.51–1.0 mm	21 %
1.5 mm	75 %	1.01–1.5 mm	35 %
2.0 mm	90 %	1.51–2.0 mm	15 %
2.5 mm	100 %	> 2 mm	10 %
			100 %

* Individual particles not bigger than
3 mm in chick superstarter- / starter diets
5 mm in grower, developer and layer

Table 9: Recommended "Nick Chick" Body Weight during the Brooding and Growing Period / Intermediate Days

Age in Weeks	Body Weight				Average Grams per Bird on Intermediate Day					
	average in g	range in g	average in lb	range in lb	1	2	3	4	5	6
1	65	62–68	0.14	0.14–0.15	73	81	89	96	104	112
2	120	115–125	0.26	0.25–0.28	128	136	144	151	159	167
3	175	168–182	0.39	0.37–0.40	185	195	205	215	225	235
4	245	235–255	0.54	0.52–0.56	256	268	279	291	302	314
5	325	312–338	0.72	0.69–0.75	336	346	357	368	379	389
6	400	384–416	0.88	0.85–0.92	414	429	443	457	471	486
7	500	480–520	1.10	1.06–1.15	513	526	539	551	564	577
8	590	566–614	1.30	1.25–1.35	601	611	622	633	644	654
9	665	638–692	1.47	1.41–1.52	676	688	699	711	722	734
10	745	715–775	1.64	1.58–1.71	756	768	779	791	802	814
11	825	792–858	1.82	1.75–1.89	836	846	857	868	879	889
12	900	864–936	1.98	1.90–2.06	909	917	926	934	943	951
13	960	922–998	2.12	2.03–2.20	970	980	990	1000	1010	1020
14	1030	989–1071	2.27	2.18–2.36	1038	1046	1054	1061	1069	1077
15	1085	1042–1128	2.39	2.30–2.49	1094	1102	1111	1119	1128	1136
16	1145	1099–1191	2.52	2.42–2.63	1154	1162	1171	1179	1188	1196
17	1205	1157–1253	2.66	2.55–2.76	1215	1225	1235	1245	1255	1265
18	1275	1224–1326	2.81	2.70–2.92	1283	1290	1298	1306	1314	1321
19	1329	1276–1382	2.93	2.81–3.05	1338	1348	1357	1366	1375	1385
20	1394	1338–1450	3.07	2.95–3.20	1400	1407	1413	1420	1426	1433

During the different growing phases of chicks and pullets, qualitatively different feed varieties should be used in which the nutrient content meets the birds changing needs. Feed mills offer a four phase feeding program (Chick Starter, Grower, Developer, Pre-Layer).
The diets are matched to the nutrient requirements and weight development at each stage of growth. The switch to developer feed should only be made when the standard body weight has been reached. A reduced nutrient density and an increased content of crude fibre (5–6 %) during this phase are beneficial for improving nutrient intake.

The use of pre-layer diets is particularly recommended for pullets reared in cage-free housing which will be transferred to floor or aviary laying facilities. (see page 28: "The correct use of a pre-layer diet")

To insure feed quality and decrease the buildup of old feed, pullets should be encouraged to "clean up" the feed once each day. An even intake of fresh, coarse and fine feed particles will be assured and nutrient intake capacity can be improved. The birds should have the ability to eat bigger meals when trained at that time. This will be an advantage for the pullets reared under these regimes as they enter the laying period when feed intake has to be sufficient enough to support increasing production and egg size.

A good nutrient intake capacity is important especially at the start of lay. Layers need the nutrients consumed for egg production as well as to facilitate growth in body weight. If pullets are too heavy at this time, they won't eat enough and as such, mobilise nutrients from body reserves for egg production.

Ad Libitum Feed Supply

H&N Layers and their breeders are specialised birds selected for a high egg production. Due to their highly efficient feed conversion they have a high demand for nutrients. Layers in full production convert roughly one third of the consumed nutrients into eggs. There is no danger in wasting feed by supplying feed ad libitum, because the hens can adjust their intake to the nutrient density of the feed. But there is a real danger in restricting birds in feed intake. An undersupply of nutrients will harm the birds. They lose production and once stressed, they easily can run into a health problem.

Table 10: Pullet Feed Consumption

Pullet Feed Intakes					
Diet	Week of Life	g/bird/day	lbs/100/day	cumulative (g/bird)	cumulative (lbs/bird)
Starter	1	10	2	70	0.15
	2	17	4	189	0.42
	3	23	5	350	0.77
Grower	4	29	6	553	1.22
	5	34	7	791	1.74
	6	38	8	1057	2.33
	7	42	9	1351	2.98
	8	46	10	1673	3.69
Developer	9	49	11	2016	4.45
	10	52	11	2380	5.25
	11	55	12	2765	6.10
	12	58	13	3171	6.99
	13	61	13	3598	7.93
	14	64	14	4046	8.92
	15	67	15	4515	9.96
	16	71	16	5012	11.05
	17	75	17	5537	12.21
Pre-lay	18	79	17	6090	13.43
	19	83	18	6671	14.71
	20	88	19	7287	16.07

Table 11: Recommended Nutrient Density in the Brood / Grow / Pre-lay Diets

Nutrient	Diet type			
	Starter*	Grower	Developer	Pre-lay
Energy (kcal / kg**) Energy (kcal / lb**)	2925 1325	2865 1300	2865 1300	2865 1300
Protein (%)	19.0–20.0	17.5–18.5	14.5–15.5	16.5–17.5
Methionine (%)	0.48	0.40	0.34	0.36
Dig. Methionine (%)	0.39	0.33	0.28	0.29
Met. + Cystine (%)	0.83	0.70	0.60	0.68
Dig. Met. / Cys. (%)	0.68	0.57	0.50	0.56
Lysine (%)	1.20	1.00	0.70	0.85
Dig. Lysine (%)	0.98	0.82	0.57	0.70
Threonine (%)	0.80	0.70	0.50	0.60
Dig. Threonine (%)	0.65	0.57	0.40	0.49
Tryptophan (%)	0.23	0.21	0.16	0.20
Dig. Tryptophan (%)	0.19	0.17	0.13	0.16
Valin (%)	0.89	0.75	0.53	0.64
Dig. Valin (%)	0.76	0.64	0.46	0.55
Isoleucine (%)	0.83	0.75	0.60	0.74
Dig. Isoleucine (%)	0.68	0.62	0.50	0.61
Calcium (%)	1.05	1.00	0.90	2.0–2.3
Phosph. tot.*** (%)	0.75	0.70	0.58	0.65
Phosphorus av.*** (%)	0.48	0.45	0.37	0.45
Sodium (%)	0.18	0.17	0.16	0.16
Chlorine (%)	0.20	0.19	0.16	0.16
Linoleic Acid (%)	2.00	1.40	1.00	1.00

* Chick Starter should be supplied if the body weight standard cannot be achieved by feeding grower or the feed intake is expected to be low.
** rounded to nearest 5 kcal
*** without phytase

Correct Use of Pre-lay Feed

Proper development of medullary bone is critical for calcium metabolism and affects a layer's ability to utilize calcium for her entire life. Because medullary bone development starts two weeks before the onset of production, it is necessary to increase the calcium level of the feed at that time to insure the bird's well-being and the long-term shell integrity of the flock.

Pre-lay feed typically contains 2.0 % to 2.5 % calcium and is fed for 10 days before the flock is put on a layer ration. Start feeding a pre-lay when the flock reaches 17 weeks of age. Be sure to watch the feed inventory during this time to insure the flock is actually consuming the pre-lay ration by 17 weeks. This process is simple if the flock is moved to the layer house at 17 weeks but requires particular attention if the flock is moved at a different time.

Feed 1.75 lb./bird of the pre-lay ration. At normal consumption levels, this will last for about 10 days. At that time the ration should be changed to a phase I layer feed (see Table 16).

Key Points

- Start using pre-layer feed based on the birds' sexual maturity, age and their standard body weights (usually 17 weeks of age).
- Use pre-layer feed for about 10 days with a maximum of 1 kg (2.2 lb) per bird. Feed 1.75 pounds of a pre-lay ration per pullet. This should last about 10 days.
- Do not start using a pre-lay ration too early, too late or use it too long.
- The pullets should be on a layer ration by the time they reach 5% production but there is no danger of harming the birds if they are on a layer ration a week or two before they start to lay.

Crude Fibre

Crude fibre, sometimes described as insoluble NSP (Non-Starch Polysaccharides), may not have nutritional values for poultry, but it does have other benefits for a healthy and stable digestive physiology. Used in the second half of the rearing period, it can positively influence the development of the digestive tract, the crop size and the appetite of pullets. This is beneficial for young layers, especially at the start of production when the appetite of the birds is sometimes insufficient to meet their nutrient demands. The tool has been proven to be very beneficial under varying feeding situations in a lot of countries.

This is the reason for the implementation of minimum recommendation of crude fibre (5 – 6 %) in the developer feed for the Nick Chick layers.

Cereals and their by-products (e.g. bran) or oil seed by-products (e.g. meal of sunflower or rapeseed), can be used as a source of crude fibre. DDGS (Dried Distillers Grains with Solubles) can be used as a source of crude fibre as well. Other raw materials, which are rich in crude fibre, may be used if available but only as long as their inclusion does not reduce the energy level of the diet. With the classical corn-soya diet, the recommended crude fibre content can hardly be achieved. In such cases, other feed ingredients must be used. For advice, please contact your chick supplier or the technical service department of H&N International.

Grit

Grit stimulates the development of the crop and the gizzard during the rearing period, which in turn has a positive effect on feed intake capacity. Although grit has benefits, it is not wise to use it until the chicks are at least three weeks old as it can build up in the crop and block the digestive tract.

Table 12: Amount and Granulation of Grit Dependent on Age

Week 3 – 8	weekly 2 g / bird (size 3 – 4 mm)
from Week 9	monthly 3 g / bird (size 3 – 4 mm)

Supplements

Supplements ensure the necessary supply of essential vitamins, trace elements and substances such as anti-oxidants or carotenoids. Suitable supplementation can compensate for the varying contents of raw materials and safeguard the supply of all necessary nutrients (see Table 13).

Table 13: Recommended Vitamin and Mineral Additions to the Finished Diets

Supplements per kg Feed		Feeding Program		
		Starter / Grower	Developer	Pre-lay / Layer
Vitamin A	IU	12000	12000	10000
Vitamin D_3	IU	2000	2000	2500
Vitamin E	IU	20–30**	20–30**	15–30**
Vitamin K_3	mg	3***	3***	3***
Vitamin B_1	mg	1	1	1
Vitamin B_2	mg	6	6	4
Vitamin B_6	mg	3	3	3
Vitamin B_{12}	mcg	20	20	25
Pantothenic Acid	mg	8	8	10
Nicotinic Acid	mg	30	30	30
Folic Acid	mg	1.0	1.0	0.5
Biotin	mcg	50	50	50
Cholin	mg	300	300	400
Antioxidant	mg	100–150**	100–150**	100–150**
Manganese*	mg	100	100	100
Zinc*	mg	60	60	60
Iron	mg	25	25	25
Copper*	mg	5	5	5
Iodine	mg	0.5	0.5	0.5
Selenium*	mg	0.2	0.2	0.2

Water

To ensure health and optimum egg quality, the water supplied to the hens should be potable. The poultry farmer should therefore always ask himself if he would be prepared to drink the water offered to his birds. Feed and water intake are closely correlated. Chicks and pullets which do not drink enough water have an inadequate feed intake. Regular checks to ensure that drinkers are working properly are therefore recommended.

It's especially necessary to check if the last nipple in the drinker line gets enough water.

When ambient temperatures are high or if birds have health problems, they consume more water. Under normal conditions, the ratio of feed and water intake is at around 1:2 (1 pound of feed / 2 gallons of water). During hot weather, water serves to regulate the birds' body temperature. Cool drinking water is best for this purpose and water temperatures above 20 °C (68 °F) should therefore be avoided. During extremely hot weather with temperatures of over 30 °C (86 °F), the feed to water intake ratio can increase to as much as 1:5. In such situations, cooling of the drinking water is beneficial.

The water consumption during the first days of a chick's life is relatively low. In a brooding barn where temperatures of 35–36 °C (95–97 °F) in the first days are optimal, water temperature will increase. It is important to flush the water lines and change the water of the fountain drinkers regularly. Good brooding temperatures and the low water consumption of the young chicks in their first days of life promote the multiplication of bugs in the drinker lines and chick founts. When water is flushed or substituted temporarily, the build up of biofilm in the drinkers can be avoided.

Table 14: Water Consumption According to Age of the Flock (at 18–22°C = 65–72 °F House Temperature)

Age (Weeks)	Water Consumption (Feed : Water)
1 – 8	1 : 1.2
8 – 18	1 : 1.2 – 1.4
from 18	1 : 1.6 – 1.8

Water meters allow regular monitoring of the hens' water consumption. They are inexpensive and easy to install. A reduction or increase in water intake can be regarded as a first warning sign of problems in the flock or with the drinker system. Minimizing water wastage reduces costs and improves the house climate.

Key Points

- Regular cleaning of the water lines in poultry buildings is essential and special attention should be paid while checking the supply tanks.
- If water from wells on the farm is used, regular tests of the water should be conducted (minimum once a year). The assessment of water quality should be based on the standards laid down in the standards in the table below.
- Birds which have access to range areas should never be allowed to drink water out of puddles.

The quality of water has to be as follows:

Parameter	Limiting Value
pH Value	≥ 6,5 and ≤ 9,5 pH-Units
Ammonia	0.50 mg / l
Nitrite	0.50 mg / l
Nitrate	50 mg / l
Chloride	250 mg / l
Sodium	200 mg / l
Iron	0.200 mg / l
Lead	0.010 mg / l
Copper	2 mg / l
Manganese	0.050 mg / l
Sulphate	250 mg / l
E. Coli	0 / 100 ml
Enterococcus	0 / 100 ml

Sour water or water containing high amounts of iron can decrease the effectiveness of vaccines and drugs.

The water consumption of the birds will clearly increase at roughly 10–14 days prior to the onset of lay. During this time, the ovary and laying organs will develop and water will be stored especially in the follicles of the ovary.

Transfer to the Laying House

The move from the growing facility to the laying house should be done gently but quickly. Catching and transporting is stressful for the birds. They also have to adapt to a strange environment. A stress-free transfer and careful acclimatisation of the flock to the new management system are crucial and contribute to good production results.
The transition from pullet to mature laying hen is characterized by basic changes in vital physiological and hormonal systems. The phase of the juvenile and body tissue growth is nearly completed and is followed by the onset of lay. At the start of egg production, however, hens' bodies are not fully developed. The growth curve will only flatten after 30 weeks of age when weekly body weight gain stays lower than 5 g.

It is advisable to move pullets from alternative rearing systems before the proposed onset of lay. This ensures that the pullets become familiar with their new surroundings before they start to lay. We recommend transferring pullets at an age of 16 to 18 weeks. Pullets have to be placed in a layer barn evenly near feeders and drinkers. **Water and feed need to be available immediately.**
Keep the water pressure inside the drinker lines low during the first days after transfer. The water drops hanging on the nipples motivate the birds to drink. As soon as the birds start to use the nipples, the pressure inside the drinker lines can be set to normal.

It is normal for pullets to lose weight after transport and housing. It is therefore important that the birds are quickly able to find feed and water to ensure sufficient feed intake. Effective ways of encouraging pullets to eat include moistening the feed, running the feeding lines more frequently, the use of skim milk powder or whey fat concentrate and vitamin supplements. **Pullets must not lose weight after being transferred. They should continue to gain weight, or at least maintain their body weight.**
If the housing system permits it and provided stocking densities are not exceeded by doing so, the pullets should be confined to the grid above the dropping pit or in the aviary.

Partially closing the scratching area (leaving the birds a minimum scratching area) and manually moving disorientated birds back into the system have also proved effective.

Upon arrival in the new barns, the light should be left on so that the hens can find their way around. In extreme cases, the light should not be switched off for up to 24 hours while observing the day / night rhythm. However, if the pullets are extremely tired on arrival, it may be desirable to turn the light off for a short period of rest.

The layer barn should be warmed up before the flocks' arrival. Cold barns can be the reason for inactive birds which don't drink and eat. House temperatures of between 18–20 °C (64–68 °F) should be achieved.

MANAGEMENT OF LAYING HENS

Housing Systems

Design of Laying Houses

This manual does not propose to describe the technical construction of cage free laying hen housing in detail. It merely outlines the basic requirements for laying houses. Before planning and executing any building work on new housing or converting existing buildings to deep litter houses and aviary systems, it is essential to consult experts.

The construction of barn systems and aviaries with winter gardens, eventually with additional range areas, must meet different and often higher standards than cage housing. As the birds spend at least some of their time directly on the barn floor, this should be heat-insulated. A lower stocking density per sq. ft. of floor space compared with conventional cages and the associated reduction in the amount of heat generated by the hens in the room must be taken into consideration when designing ventilation and air-conditioning.

The dispersion of the hens within the building depends on its size, compartments within the barn and in particular, air flow and house climate. If the latter two factors are relatively uniform, the hens will disperse evenly within the barn and feel comfortable. Otherwise, the birds will crowd together in areas of the layer house they find suitable. The litter in such overused areas can become heavily soiled, the proportion of harmful gases can rise and in the worst case scenario, the hens could suffocate to death.

Nests must be easily accessible to all hens and preferably positioned in a central location in the laying house. No spot within the layer house should be more that 20 feet from a nest. As the hens can choose whether or not to use the nests for egg laying and since not every hen would have learned to lay eggs in the nest, some eggs will be laid in the scratching area, on the dropping pit or in the aviary system. It is therefore crucial to get the hens accustomed to the nest.

Eggs laid outside of the nests ar hygienically undesirable and should be picked up as soon as possible to discourage other hens from laying in the same area.

In barn systems or aviaries, a large quantity of dust is generated by hens using the littered scratching area and moving about. This can pose a health hazard for the birds.

If barns are combined with a range area, the building should be aligned in a north-south direction. This prevents the walls from heating up at different rates and differences in the amount of light entering the two halves of the building when the pop holes are open.

The design of the building and its installations should be user-friendly to allow easy servicing.

Floor Systems

Floor systems for laying hens can vary considerably in design and layout depending on the type of building. The classic form consists of 60 to 80 cm (24 to 32 in.) high dropping pits covered with wooden, wire mesh or plastic slats. These take up two-thirds of the floor space.

Feeders, drinkers and laying nests should be positioned on top of the dropping pit and the drinkers should be mounted at a distance of 30 to 50 cm (12 to 20 in.) directly in front of the entrance to the nest.

A littered scratching area of sand, straw, wood shavings or other materials which occupies one-third of the floor space, gives the hens room to move, scratch and dust bathe. In some cases houses are constructed with wall to wall wood or plastic slats and a winter garden is added to the house as a place for scratching and dust-bathing. The littered scratching area takes up about one-third of the total floor space, but can be replaced completely with perforated flooring in a modified variant. In this case, it is recommended to provide an additional winter garden where the birds can express their natural behaviors such as scratching and dust-bathing.

Stocking densities should not exceed 9 hens per m² = 0.8 hens per sq. foot (of usable floor space). Rails or other elevated perching facilities should be provided as a place for less aggressive hens to take refuge from their more aggressive peers.

Aviary Systems

Aviaries are systems in which birds can roam on several levels. The levels are covered with wire mesh, plastic slats or are made out of wood. Manure belt ventilation can also be installed if desired. Feeding and drinking equipment are usually located on the lower tiers. The upper tiers usually serve as resting areas for the birds. Depending on the aviary system, the laying nests are either within the system or outside. **A stocking density of up to 18 hens per m² = 1.6 hens per sq. foot of floor area can be used in this housing system.** Controlled lighting and staggered feeding times encourage the birds to move around the different levels.

Manufacturers now supply a wide range of aviary systems where laying hens can be kept successfully and achieve high production. Before deciding on which system to use, the egg producer should look at the existing construction and select an installation that can be readily adapted to the existing building. When constructing a new facility, the layout of the house and the aviary installation should preferably be designed to match. If the aviary system where the pullets were raised is similar to the type installed in the subsequent laying house, familiarisation problems can be minimized. This aspect should also be considered when establishing an aviary system for laying hens.

Free Range Systems

In free range systems, a normal barn or aviary system is combined with an outdoor range area for the hens. The range area must be available to the birds during the day. Pop holes spread along the entire length of the building provide access to the exterior. A winter garden attached to the poultry house has proven to be highly beneficial. The hens cross the winter garden to get to the range area. Winter gardens in front of the laying house have a positive effect on both litter quality and the climate of the house. Most of the dirt carried by the hens from outside remains in the winter garden. Since cold air cannot flow straight into the building when the pop holes are opened, the climate indoors would not be so greatly affected as it would be without a winter garden.

The egg producer should also bear in mind that in order to successfully adapt hens to cage free systems, other factors need to be considered which may have to be discussed with the pullet supplier. **The more closely the growing facility resembles the future production system, the easier it will be for the pullets to settle down in their new barn.**

Range

Range areas have to be offered to layers according to the weather conditions. Hens should be kept inside the barn three weeks after transfer. This ensures a complete adaptation to the equipment inside. Thereafter, the pop holes can be opened. If a winter garden is available, the birds should have access to the same one week prior to the opening of the pop holes to the range.

During lay, pop holes should be opened after the main laying time. Rules concerning the availability of the ranges as stipulated in the marketing of "Free Range Eggs" have to be followed. Young flocks going outside for the first time need to be trained in the use of the range. The route from the laying house to the outside and back must be easy to find. Food and water should only be available indoors.

Pasture Ranges

Hens readily accept the range if the pasture area is surrounded by a few trees or bushes which provide protection from predators. The area closest to the laying house will be heavily used by the flock and the grass becomes worn.

The range area has to be well maintained. Hens tend to use the areas closest to the barn intensively, consume all the grass and the ground will get more compacted as a result of this. Water can't evaporate easily thereby resulting in undesirable puddles.

The range area is a real challenge for maintaining a high hygienic status. It is beneficial to carry out an annually dressing with lime for the range.The flock can't have access to this area for a period of two weeks.

Depending on the condition of this part of the range, care of the grounds and disinfection measures should be carried out. Pasture rotation has proved effective in practice.

Young pullets ranging on pastures with good vegetation for the first time tend to ingest numerous plants, stones, etc. This can greatly reduce their feed intake capacity. Failure to consume sufficient feed, especially during the phase of peak egg production, will jeopardise the hens' nutrient supply. In practice, this often leads to weight loss, reduced production and increased susceptibility to disease.

Young flocks should therefore be gradually introduced to using the ranges. It is essential to ensure that the hens consume sufficient feed.

Perimeter Fence

A solid perimeter fence for the range is a one time investment that is definitely worthwhile. Range areas must be kept free from foxes, stray cats and dogs, weasels and raccoons. A two meter (6.5 ft.) high fence provides protection from predators. An external electric fence can increase the level of protection.

Management

Management during the early Days

During the first few days after housing, it is important to stimulate sufficient feed intake. The hens should be encouraged to increase their feed consumption as quickly as possible.

Some ways to achieve this are to:

- Provide an attractive type of feed with good texture
- Run the feeding lines more frequently
- Feed on an empty trough
- Illumination of the feeder lines
- Moistening the feed
- Use of skim milk powder or whey-fat concentrate
- Vitamin supplements

Pullets should not lose weight after being transferred. They should continue to gain weight, or at least maintain their body weight.

Lamps should be placed in such a way that the entire building and the entrance to the nests are well-lit. These should be programed so that only the light above the dropping pit or above the resting zones of the aviary system is on before the end of the lighting day. This will enable and motivate the hens to get back to the system at the end of the day.

Litter

The type and quality of the litter are of importance for the hens and the climate of the house. Different materials may be used:

- Wood shavings
- Cellulose pellets
- Coarse wood shavings
- Wheat, rye straw
- Bark mulch
- Sand or gravel up to 8 mm (0.25 in.) granule size

Regardless of the litter material used, it should be absolutely hygienic.

Wood shavings should be dust-free and not chemically pre-treated. Straw must be clean and free of mold. Sand and gravel should be dry when distributed. A litter depth of 1 – 2 cm (0.4 – 0.8 in.) is sufficient. Litter should preferably be distributed after the hens have been housed and be spread by the hens themselves if possible. This prevents the formation of condensed water between the floor and litter. Straw litter has the advantage of encouraging the hens to forage in the litter material. This stimulates their natural investigative and feeding behavior and reduces vices. Removal and replacing of litter in heavily frequented areas of the building is often unavoidable during the laying period.

To prevent litter from sticking together, it is recommendable to distribute whole grain to critical areas in the barn once a day. Birds increase pecking and scratching in these areas and the litter depth will be reduced. Not more than one lb grain per 100 birds per day should be supplied to maintain a good feed intake. Winter gardens in front of the laying house have a positive effect on litter quality. When the pop holes are opened, cold air does not flow directly into the building. As such, the climate indoors will be less affected then it would be without a winter garden.

House Climate

Room temperatures of 18 °C (64 °F) are considered optimal for laying hens in cage free systems. Housing temperatures between 18–20 °C (64–68 °F) are considered optimal for laying hens in cage-free systems. Relative humidity up to 70 % can be tolerated. Lower temperatures during the winter months will also not pose a problem for the hens, i.e. if they have gotten used to them. High temperatures exceeding 30 °C (86 °F) are however, less well tolerated. During heat spells, when room temperatures above 30 °C (86 °F) are unavoidable, sufficient air circulation around the hens should be ensured to help the birds give off body heat into the atmosphere. The use of additional fans in the poultry house is highly effective in such situations. In extremely hot climates the addition evaporative coolers should be considered as a method of reducing house temperatures.

Hens which have access to a winter garden or an outdoor enclosure should be adapted to colder winter temperatures. The quality of the plumage needs to be taken into consideration in temperature management programs for laying hens in cage-free housing. Climate and room temperature are heavily influenced by the activity of the birds, stocking density and the presence of pop holes, if any.

Drafts of cold air are harmful for the birds. Drafty areas are avoided by the hens which prefer to congregate in poorly ventilated parts of the building. Mortalities due to smothering and the incidence of floor eggs are caused in part by poor ventilation. The ventilation system should ensure that warm air is extracted quickly from the birds' surroundings in summer and that the building does not become too cold in winter. High concentrations of noxious gases should be avoided. Ammonia reduces the bird's comfort and is also hazardous to health. A well designed winter garden and the use of a bird lock or a wind protection device like a strip curtain can prevent controlled airflow from being interrupted when the negative pressure system is active. If problems in the ventilation of the barn or aviary houses occur, it is advisable to consult a specialist. Recommendations on the concentration of individual gases can be found in table 2 on page 12.

Equipment

The more closely the growing facility resembles the future production system, the easier it will be for the pullets to settle down in their new surroundings. Simple things like a difference in the color or functionality of the nipple drinkers can hinder hens from easily adjusting themselves to the new environment.

Laying Nests

Laying nests should be designed and positioned in such a way that they are easily accessible to the hens, preferably in a central location in the barn. It is recommended to keep the entrance to the nest well-lit whereas the interior should be darkened.

Pullets should not be allowed access to the nests late in the day or during the night but they must have access just before the onset of lay. This enhances the attractiveness of the nest and improves nest acceptance.

During the laying period, the nests should be opened 2 – 3 hours before the start of the lighting day and closed 2 – 3 hours before the end of the lighting day.

Closing the nests at night prevents soiling and broodiness. Close-out prevents the hens from roosting in the nests overnight. Tilting nest floors has proven to help keep the floor of the nest box clean.

Important Remark:

Before eggs are laid every morning, the egg belt should be moved once in a complete circle. By doing so, dust and manure can be removed and laid eggs can roll down onto a clean belt. Ensure that eggs which have been laid in the afternoon of the previous day, be collected in the evening so that this does not disrupt the cleaning process.

Key Points

What makes nests attractive?

1. The right position: a calm place. Drinkers should be installed in front of the nests
2. Comfortable nest floor: Astro Turf, rubber floor, litter (chaff of grain or spelt straw).
3. The right intensity of light: Light the entrance of the nest very well. The inside of the nest should however, be kept dark (1 Lux = 0.1 foot candle).
4. Sufficient number of nests.
5. Avoidance of draft in nests.

Lighting

The best source of light for laying hens is a high frequency bulb emitting light within the warm white (2500-4000 °K) spectrum (frequency range above 2000 Hz). Low frequency Fluorescent tubes or energy-saving bulbs (50 – 100 Hz) have a strobe light effect on hens and encourage feather pecking and cannibalism (this does not happen with incandescent bulbs). Lamps should have a dimmer switch.

LEDs (**l**ight **e**mitting **d**iodes) can also be used in non-cage rearing and production systems for laying hens. LEDs emitting white light are preferable, especially those which can be used underneath and within the systems. If LEDs are used to illuminate the full house warm white LEDs are prefarable as well.

Table 15: Equipment Requirement for Production Period

Equipment / Adjustment	Requirement
Darkness	At least 8 hours or natural dark phase
Distances	Max. 8 m (26 feet) to feeder / drinker
Feeder Space	Feeding trough: 5 m (15 feet) / 100 hens Round feeder: 4 feeders (ø 40 cm = 16 in.) for 100 hens
Drinkers	Chain drinkers: 1 running meter for 80 – 100 hens Bell drinker: 1 drinker (ø 46 cm = 18 in.) for 125 hens Nipple: 1 Nipple for 6 – 8 hens
Nests	Single nests: 1 Nest (26 x 30 cm = 10 x 12 in.) / 4 hens Group nests: 120 hens/m^2 (11 hens/sq. foot)
Perches	15 cm (6 in.) / hen; distance between perches 30 cm (12 in.)
Dropping Pit	80 – 90 cm (32-36 in.) deep to hold the droppings from one batch if manure scraper is available; 7° gradient up to the nest
Proprotion of Litter Area	At least 33 % of the floor area
Pop Holes	Minimum size: 45 cm (18 in.) in height for 500 (12.5) hens per running m (in.). Pop holes from barn to winter garden and those from winter garden to range should spread out

The stocking densities have to be adjusted in accordance to the animal welfare regulations valid for the country where the hicks / pullets are housed. Organic egg producers might have to follow different or specific regulations.

When simulation dusk and dawn by dimming, a proper dimmer, must be used otherwise the light may flicker and makes birds nervous.

Keep in mind, that LED light is directional and requires an appropriate lens to focus light, or appropriate diffusers to cover a broader area in the barn.

Lighting Programs

Bear in mind that a flock should never have to experience an increasing day length until the stimulation has been planned. Furthermore, the day length should never be decreased during the production period. In barns which can be darkened, this should not be a problem if air inlets and exhausting fans are trapped by light. In this case, optimal lighting programs for Nick Chicks can be used.

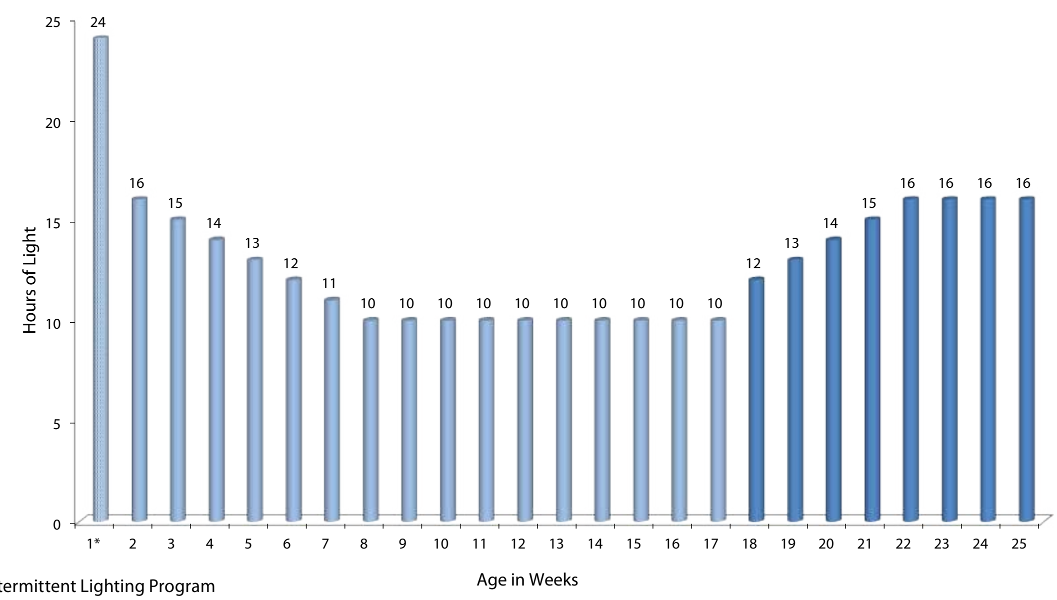
Special Considerations for Hens kept in Buildings with natural Daylight

When designing the lighting program for housing, it should be taken into consideration whether hens have access to winter gardens or an outdoor enclosure, or if windows, ventilation shafts and other openings cannot be blacked out sufficiently to protect the birds completely from the effects of natural daylight.

Advice on how to create lighting programs for facilities which are influenced by natural daylight (the seasonal swing of the length of day) can be found on page 17.

It makes a difference whether the housed pullets come from a windowless growing facility or if they were reared in a building whose windows were blacked-out in synchronicity with the lighting program or whether they were fully exposed to natural daylight during the growing period.

Figure 5: Step Down then Constant Lighting Program



In the case of hens which did not realise the natural change of the lighting day during rearing (windowless housing or windows with blackout facility), it is important to avoid excessive stimulation when transferring the same to open laying houses. This will result in stress due to the abrupt lengthening of the day (in spring and summer). An increase in the day length by not more than 2 – 3 hours is desirable.

In open housing, the lighting program in the spring and summer months are determined by the length of the natural day which reaches a maximum in mid summer. When the natural day length begins to decrease the length of the day should be constantly maintained until the end of the laying period.
This is easily achieved by using an automatic time clock and dimmer switch.

The egg producer and the pullet supplier should agree on the following in order to coordinate lighting programs during rearing and the subsequent laying period:

- For pullets which are moved to open housing with windows that do not have a blackout facility, an option would be to design lighting programs which are synchronised with the hatching date of the flock. In order to avoid a "light shock" if re-housing were to take place during a period of very long days, the step-down program during rearing should be modified in such a way that upon transfer to the laying house, the hens are exposed to an increase in day length of not more than two or three hours at the most (see figure 3, page 17).
- If technically possible, open housing for laying hens should also have facilities for blacking out the windows. These could then be opened and shut in synchronicity with the lighting program or remain completely shut until the maximum day length has been reached (in accordance with the lighting program).
- Hens reared under artificial light and later moved to housing with natural daylight have to get used to the altered perception of their surroundings.
- Pullets reared in buildings that cannot be darkened are affected by the length of the natural day, especially in the spring and summer months. Early maturing of pullets can only be prevented by adapted lighting programs, but effective stimulation of such hens with lighting programs is only possible to a certain extent.

Crucial points to consider in the management of laying hens, the choice of light sources and the design of lighting programs:

- Artificial light from fluorescent bulbs operating within a frequency range at 50 – 60 Hz is perceived as flickering by hens. Incandescent bulbs or fluorescent tubes operating at high frequencies over 2000 Hz are preferable.
- Artificial filtered light, but also unfiltered light from conventional light sources, restricts the vision of hens by limiting the light spectrum that is visible to them.
- Stimulation of hens in windowless housing follows the simple principle of shortening the light period until the desired stimulation time has been achieved, followed by a lengthening of the light period. A reduction of the day length during the laying period is not allowed.
- If technically possible, open housing for laying hens should also have facilities for blacking out the windows. These could then be opened and shut in synchronicity with the lighting program or remain completely shut until the maximum day length has been reached (in accordance with the lighting program).

Flock Control

In the first days after housing, the foundations are placed for the behavior of the flock during the laying period. Paying special attention to detail during the first two weeks after moving the flock to a cage free production system will result in ample dividends later on.
Every morning after the light is switched on, it is necessary to conduct a thorough inspection. This should comprise checks for the proper functioning of:

- Drinkers
- Feeders
- Lighting installations and
- Laying nests

The climate of the house should be checked and the condition of the flock and the hen's behavior assessed.

Floor Eggs

Immediately after the start of lay, multiple inspections are recommended to collect floor eggs, if any. This helps the hens to get used to the attendants while at the same time, rapidly reducing the quantity of floor eggs.

The occurrence of floor eggs can be reduced by incorporating the following experiences in the design of the laying house and the management of young flocks:

- Laying nests should be readily accessible to the hens and positioned in a central location in the barn
- The entire building should be well-lit, dark corners and excessively littered scratching areas should be avoided
- Drafty nests disturb the hens during lay and should therefore be avoided
- The entrance to the nest must be clearly visible to the hens.
- Additional lighting of the interior of the nest can improve nest acceptance at the onset of lay.
- Litter depth should not exceed 2 cm (0.8 in.) at the onset of the laying period. Light-coloured litter material is preferable to dark material.
- Feeders and drinkers should not be more than 2 to 3 meters (6.5 to 10 feet) away from the nest area.
- The provision of drinking water in the vicinity of the nest entices the hens to this area.
- Feeders and drinkers should be positioned in such a way that they do not create attractive areas for egg laying or obstruct access to the nests.
- If nest boxes are mounted on the dropping pits, the perforated floors should have a gradient of about 7° towards the nest. This increases the motivation of the hens to deposit eggs in the nest.
- If walkable surfaces are installed in front of the nests, these should incorporate barriers every two meters to stop the hens from parading in front of the nests and blocking the access.
- The laying nests should be opened 10 to 14 days before the onset of lay.
- Hens should not be disturbed while laying eggs. Avoid feeding at this time, if possible.
- Do not carry out flock inspections during the main laying period in the morning.
- Floor eggs should be collected quickly and if possible, several times a day.
- If floor eggs still occur, increasing the day length by adding an extra hour of light at the start of the day is often an effective solution.

Animal Health

Vaccinations

Pullets destined for deep litter, aviary systems and free range are vaccinated in the rearing period against viral (Marek's Disease, IB, ND, Gumboro, ILT), bacterial (Salmonella) and parasitic diseases (Coccidiosis) (see "Vaccination" in chapter "Rearing Pullets").

In cage free layer housing systems, the infection pressure from Fowlpox and EDS is so high that the birds should also be vaccinated against these diseases, if there are any risks of infection. Combined vaccinations against IB, ND, EDS and sometimes also against ART are widely applied. Booster vaccinations against IB are advisable at 6 – 8-week intervals.

In addition to the vaccinations given during rearing, an additional booster vaccination is required for the high infection pressure of Salmonella.

Bacterial infections such as E. coli, Erysipelas and Pasteurella Multocida are common in cage free production systems. Outbreaks depend on the type of infectious agent, the infection pressure and the condition of the flock.

Immune protection can also be achieved by combined vaccinations. Treatment of bacterial infections in laying hens is less effective than vaccination and is often prohibited.

As there are currently no legal medications available for Coccidia, Pasteurella, Erysipelas etc., preventive vaccination with autogenous vaccines is therefore advisable. This initial outlay can help prevent high losses and a premature end to production. The bacteria causing Erysipelas and Pasteurella infections are usually found in rodents in the vicinity of affected hens. Effective control of mice and rats is an important tool for prevention.

A local veterinarian should be consulted when setting-up a vaccination schedule as he would be aware of the disease situation in the region.

Parasites

Roundworms and Tapeworms occur in hens and are transmitted via the droppings. If worm infestation is suspected, a swab of faecal sample should be taken and sent to a veterinary laboratory for analysis. If necessary, the flock may have to be de-wormed.
Poultry mites are a major problem in cage free production systems. They damage health and affect the productivity of flocks. Heavy infestation can also cause high mortalities (by transmitting diseases). Infestation causes distress in the flock (feather pecking, cannibalism, depressed production). Continuous monitoring of the flock is therefore advisable.

Rodent Pests

Housing for laying hens should be free of rats and mice. They carry disease and are often the cause of bacterial infections in the flock. Rats and mice are often carriers of Salmonella as well. A severe rodent infestation should be eradicated immediately and effectively by a professional pest controller.

The use of suitable building materials, good structural maintenance and the closing of all openings in the walls of the building (ventilation grids) are ways of keeping rodent numbers down. Shingles and pebbledash (1 – 2 m = 3 – 6.5 feet applied to exterior walls) are avoided by rats and can reduce their numbers in the vicinity of poultry buildings.

Behavioral Disorders

Watch closely for any signs of abnormal behavior such as feather pecking or cannibalism. If feather pecking or cannibalism suddenly occurs, the same parameters as mentioned in the rearing chapter (see page 14) should be looked at.

The following measures can be taken when behavioral disorder occurs:

- Reduce light intensity
- Enrich the environment: supply grain into the litter, place soft rocks or bales of alfalfa in the barn to motivate the hens to occupy themselves
- Make sure that hens empty the trough once a day to avoid selective eating
- If applicable, reduce stocking density or form small groups

Feeding

The nutrient requirement of laying hens is divided into three categories: Maintenance, Growth and Egg Production.
Because of higher activity levels, the maintenance requirement of cage-free layers for energy is considerably higher than that of cage layers. It has been calculated that hens in cage-free housing require 10% more energy then caged birds. The energy requirement for free range hens is 15% higher. For this reason laying rations must be formulated to match the housing system. The requirement for growth declines greatly after the hens reach 30 weeks of age. Under most conditions, hens will take care of their maintenance requirements first and any shortage in nutrition will express itself as reduced growth or after 30 weeks of age as depressed egg production.

The daily nutrient intake of laying hens can be calculated using the following formula:

Nutrient content in the diet

x

Feed intake /hen/ day

=

Nutrient intake /hen / day

Example: 2720 kcal / kg x 105 g / hen / day

1300 kcal / lb x 22 Lbs. / 100 / day

=

286 Kcal / hen / day

The necessary prerequisites for a good and sufficiently high nutrient intake of hens are:

- a diet with a sufficiently high energy content / nutrient density
- and an adequate feed intake

Raising the nutrient density/nutrient content of layer diets is not always economically viable. As such, an adequate feed intake per hen and day is an important prerequisite for the hen's normal genetic production potential.

The feed intake capacity of the laying hen is determined by many factors and can also be altered by genetic measures. It is mainly dependent on:

- The hen's body weight
- Laying performance
- Activity level of the hens
- Ambient temperature
- Condition of the hen's plumage
- Energy content of the ration
- Health status

In cage free systems, pullets are sometimes moved to the laying house as early as 16 – 18 weeks old. At that age, however, the birds are not fully developed yet and should therefore not be fed with a layer diet.

The high calcium content of a layer diet would prematurely stimulate the hens to lay eggs. Layer diets with more than 2.5 % calcium should therefore not be introduced too early. Before 19 weeks of age the hens in the laying house should be on a pre-lay diet. Under normal circumstances the hens should be changed to a layer ration at about 19 weeks of age even if production has not yet reached 5 %. The time for feeding a pre-layer diet and the best time for switching should be coordinated with the pullet supplier. Precise information concerning the correct use of the pre-layer diet can be found in the chapter rearing on page 28.

The changes occurring during the transition phase from pullet to laying hen often lead to a reduced feed intake, which may, in some cases, drop well below requirements (see table 10, page 26). This depressed rate of consumption does not meet the hen's nutrient requirement at that age and based on the standard energy levels of commercial layer rations, must definitely be considered too low. A suboptimal nutrient supply at the onset of lay places a strain on the birds' metabolism as endogenous energy reserves have to be mobilized and it can potentially contribute to the development of fatty liver syndrome.

During this phase, every effort must be made to increase the feed intake as quickly as possible to at least the age appropriate intake levels in table 10.

Measures for increasing feed intake in this critical phase:

- Frequently operate the feeders
- Wet the feed slightly
- Feed on an empty feeder
- Use only feed of excellent structure
- Keep light intensity high

Feeding in the Lay Cycle

H&N "Nick Chick" can achieve her genetic performance potential using many different feeding programs. However, there are some precautions with regard to the lay diet that should be kept in mind. All layers require a minimum quantity of daily nutrients regardless of their consumption rate, but their actual intake is primarily governed by their energy requirements. Energy requirements are in turn determined by body weight, production rate, egg size, ambient temperature, air movement and feathering. **To supply the prolific H&N layers with sufficient nutrients an ad libitum feed supply is recommended. All figures mentioned in this manual are only guidelines.**

Feeding at Onset of Production and Through Peak

At 1 % production a peaking diet should be fed if a pre-lay diet has been used. If a pre-lay diet is not used, begin the use of the peaking diet at 18 weeks of age. The peaking diet can be a special diet which is designed for those layers at 100 % production. Recommended vitamin and trace mineral levels are found in Table 13.

Flocks in hot climates may not be able to consume normal amounts of feed. Such flocks should be fed denser diets (higher in nutrient concentration) as a means of compensating for low feed consumption.

Feeding after Peak

Adjustments in the feed formula for laying hens must be made, depending upon the quantity of feed consumed and rate of lay, to assure adequate nutrient intake for maximum production and egg size. Review the information in Tables 16 through 21. After peak production (about 40 weeks of age) the diets should be changed in accordance to tables 18 –21.

Condition of Plumage and Feed Intake

Maintaining the hens plumage in good condition throughout the production period should be a major concern of every egg producer. In doing so, he fulfils his legal obligations under animal welfare laws, but well-maintained plumage is also essential for keeping the hens in good health. Good plumage protects the birds against heat loss thus reducing excess feed consumption. The increased feed and nutrient requirement of hens with damaged plumage increases the maintenance requirement, which accounts for 60 – 65 % of the total nutrient requirement. The increased energy consumption is necessary for the birds to maintain body temperature. A daily feed consumption of 25 pounds / 100 birds or more is therefore not unusual in special situations.

Grit

Insoluble grit or fine gravel should be provided for free access feeding, also for fully grown laying hens. Due to the specialised digestive system of birds, this can stimulate digestion and improve nutrient intake capacity.
The following are reference values for granulation and amount of grit to be supplied:

Once a Month 1 lb/100 birds (1/8th inch granulation)

Table 16: Condition of Plumage and daily Energy Maintenance Requirement (at 64–72 °F House Temperature)

	Plumage (%)					
	100	90	80	70	60	50
Additional maintenance requirements (kcal)	0	7.5	14.4	21.6	28.8	36
Additional feed requirement (g / day) *	0	0.57	1.14	1.71	2.28	2.87

* Feed with 1,257 kcal or 5.27 MJ/lb

Source: Peguri et al., 1993

Table 17: Nutrient Levels of Diets from 20 –40 Weeks at various Feed Intakes to Provide the Recommended Daily Nutrient Intake

G/bird/day:	90	95	100	105	110
Lbs. Feed/100/Day Energy (kcal/lb)*	19.8 1445	20.9 1370	22 1300	23.1 1240	24.2 1180
Protein (%)	20.00	18.95	18.00	17.14	16.36
Calcium (%)	4.33	4.11	3.90	3.71	3.55
Phosphorus (%)**	0.71	0.68	0.64	0.61	0.58
Av. Phosphorus (%)	0.50	0.47	0.45	0.43	0.41
Sodium (%)	0.20	0.19	0.18	0.17	0.16
Chlorine (%)	0.20	0.19	0.18	0.17	0.16
Lysine (%)	0.00	0.87	0.83	0.79	0.75
Dig. Lysin (%)	0.76	0.72	0.68	0.65	0.62
Methionine (%)	0.45	0.43	0.41	0.39	0.37
Dig. Methionin (%)	0.37	0.35	0.33	0.32	0.30
Met. + Cys. (%)	0.83	0.79	0.75	0.71	0.68
Dig. Met.+Cys. (%)	0.68	0.64	0.61	0.58	0.56
Arginine (%)	0.95	0.90	0.85	0.81	0.78
Dig. Arginine (%)	0.78	0.74	0.70	0.67	0.64
Valine (%)	0.77	0.73	0.70	0.66	0.63
Dig. Valine (%)	0.66	0.62	0.59	0.56	0.54
Tryptophan (%)	0.20	0.19	0.18	0.17	0.17
Dig. Tryptophane (%)	0.17	0.16	0.15	0.14	0.14
Threonin (%)	0.64	0.61	0.58	0.55	0.53
Dig. Threonine (%)	0.53	0.50	0.48	0.45	0.43
Isoleucine (%)	0.74	0.70	0.66	0.63	0.60
Dig. Isoleucine (%)	0.60	0.57	0.54	0.52	0.49
Linoleic acid (%)	2.22	2.11	2.00	1.90	1.82

* A nutritionist should be consulted if the energy levels above 1370 or below 1240 kcal/lb (2980 or below 2755kcal/kg)

** Without Phytase

Table 18: Nutrient Levels of Diets from 41 – 50 Weeks at various Feed Intakes to Provide the Recommended Daily Nutrient Intake

G/bird/day:	90	95	100	105	110
Lbs. Feed/100/Day Energy (kcal/lb*)	19.8 1445	20.9 1370	22 1300	23.1 1240	24.2 1180
Protein (%)	19.70	18.66	17.73	16.89	16.12
Calcium (%)	4.56	4.32	4.10	3.90	3.73
Phosphorus (%)**	0.70	0.67	0.63	0.60	0.58
Av. Phosphorus (%)	0.49	0.47	0.44	0.42	0.40
Sodium (%)	0.20	0.19	0.18	0.17	0.16
Chlorine (%)	0.20	0.19	0.18	0.17	0.16
Lysine (%)	0.00	0.86	0.82	0.78	0.74
Dig. Lysin (%)	0.74	0.71	0.67	0.64	0.61
Methionine (%)	0.44	0.42	0.40	0.38	0.36
Dig. Methionin (%)	0.36	0.35	0.33	0.31	0.30
Met. + Cys. (%)	0.82	0.77	0.74	0.70	0.67
Dig. Met.+Cys. (%)	0.67	0.63	0.60	0.57	0.55
Arginine (%)	0.93	0.89	0.84	0.80	0.76
Dig. Arginine (%)	0.77	0.73	0.69	0.66	0.63
Valine (%)	0.76	0.72	0.69	0.65	0.62
Dig. Valine (%)	0.65	0.61	0.58	0.55	0.53
Tryptophan (%)	0.20	0.19	0.18	0.17	0.16
Dig. Tryptophane (%)	0.16	0.16	0.15	0.14	0.13
Threonin (%)	0.64	0.60	0.57	0.54	0.52
Dig. Threonine (%)	0.52	0.49	0.47	0.45	0.43
Isoleucine (%)	0.73	0.69	0.65	0.62	0.59
Dig. Isoleucine (%)	0.60	0.56	0.54	0.51	0.49
Linoleic acid (%)	2.22	2.11	2.00	1.90	1.82

* A nutritionist should be consulted if the energy levels above 1370 or below 1240 kcal/lb (2980 or below 2755kcal/kg)
** Without Phytase

Table 19: Nutrient Levels of Diets from 50 – 65 Weeks at various Feed Intakes to Provide the Recommended Daily Nutrient Intake

G/bird/day:	90	95	100	105	110
Lbs. Feed/100/Day Energy (kcal/lb*)	19.8 1445	20.9 1370	22 1300	23.1 1240	24.2 1180
Protein (%)	19.40	18.38	17.46	16.63	15.87
Calcium (%)	4.67	4.42	4.20	4.00	3.82
Phosphorus (%)**	0.69	0.66	0.62	0.59	0.57
Av. Phosphorus (%)	0.49	0.46	0.44	0.42	0.40
Sodium (%)	0.20	0.19	0.18	0.17	0.16
Chlorine (%)	0.20	0.19	0.18	0.17	0.16
Lysine (%)	0.00	0.85	0.80	0.77	0.73
Dig. Lysin (%)	0.73	0.69	0.66	0.63	0.60
Methionine (%)	0.44	0.41	0.39	0.38	0.36
Dig. Methionin (%)	0.36	0.34	0.32	0.31	0.29
Met. + Cys. (%)	0.80	0.76	0.72	0.69	0.66
Dig. Met.+Cys. (%)	0.66	0.62	0.59	0.57	0.54
Arginine (%)	0.92	0.87	0.83	0.79	0.75
Dig. Arginine (%)	0.75	0.72	0.68	0.65	0.62
Valine (%)	0.75	0.71	0.68	0.64	0.61
Dig. Valine (%)	0.64	0.60	0.57	0.55	0.52
Tryptophan (%)	0.20	0.19	0.18	0.17	0.16
Dig. Tryptophane (%)	0.16	0.15	0.15	0.14	0.13
Threonin (%)	0.63	0.59	0.56	0.54	0.51
Dig. Threonine (%)	0.51	0.49	0.46	0.44	0.42
Isoleucine (%)	0.72	0.68	0.64	0.61	0.59
Dig. Isoleucine (%)	0.59	0.56	0.53	0.50	0.48
Linoleic acid (%)	1.67	1.58	1.50	1.43	1.36

* A nutritionist should be consulted if the energy levels above 1370 or below 1240 kcal/lb (2980 or below 2755kcal/kg)
** Without Phytase

Table 20: Nutrient Levels of Diets from 65 – 80 Weeks at various Feed Intakes to Provide The Recommended Daily Nutrient Intake

G/bird/day:	90	95	100	105	110
Lbs. Feed/100/Day Energy (kcal/lb*)	19.8 1445	20.9 1370	22 1300	23.1 1240	24.2 1180
Protein (%)	18.60	17.62	16.74	15.94	15.22
Calcium (%)	4.78	4.53	4.30	4.10	3.91
Phosphorus (%)**	0.66	0.63	0.60	0.57	0.54
Av. Phosphorus (%)	0.47	0.44	0.42	0.40	0.38
Sodium (%)	0.20	0.19	0.18	0.17	0.16
Chlorine (%)	0.20	0.19	0.18	0.17	0.16
Lysine (%)	0.00	0.81	0.77	0.73	0.70
Dig. Lysin (%)	0.70	0.67	0.63	0.60	0.57
Methionine (%)	0.42	0.40	0.38	0.36	0.34
Dig. Methionin (%)	0.34	0.33	0.31	0.30	0.28
Met. + Cys. (%)	0.77	0.73	0.69	0.66	0.63
Dig. Met.+Cys. (%)	0.63	0.60	0.57	0.54	0.52
Arginine (%)	0.88	0.84	0.79	0.76	0.72
Dig. Arginine (%)	0.72	0.69	0.65	0.62	0.59
Valine (%)	0.72	0.68	0.65	0.62	0.59
Dig. Valine (%)	0.61	0.58	0.55	0.52	0.50
Tryptophan (%)	0.19	0.18	0.17	0.16	0.15
Dig. Tryptophane (%)	0.15	0.15	0.14	0.13	0.13
Threonin (%)	0.60	0.57	0.54	0.51	0.49
Dig. Threonine (%)	0.49	0.47	0.44	0.42	0.40
Isoleucine (%)	0.69	0.65	0.62	0.59	0.56
Dig. Isoleucine (%)	0.56	0.53	0.51	0.48	0.46
Linoleic acid (%)	1.33	1.26	1.20	1.14	1.09

* A nutritionist should be consulted if the energy levels above 1370 or below 1240 kcal/lb (2980 or below 2755kcal/kg)
** Without Phytase

Table 21: Nutrient Levels of Diets from 80 – 85 Weeks at various Feed Intakes to Provide the Recommended Daily Nutrient Intake

G/bird/day:	90	95	100	105	110
Lbs. Feed/100/Day Energy (kcal/lb*)	19.8 1445	20.9 1370	22 1300	23.1 1240	24.2 1180
Protein (%)	18.20	17.24	16.38	15.60	14.89
Calcium (%)	5.00	4.74	4.50	4.29	4.09
Phosphorus (%)**	0.65	0.62	0.59	0.56	0.53
Av. Phosphorus (%)	0.46	0.43	0.41	0.39	0.37
Sodium (%)	0.20	0.19	0.18	0.17	0.16
Chlorine (%)	0.20	0.19	0.18	0.17	0.16
Lysine (%)	0.00	0.79	0.75	0.72	0.69
Dig. Lysin (%)	0.69	0.65	0.62	0.59	0.56
Methionine (%)	0.41	0.39	0.37	0.35	0.34
Dig. Methionin (%)	0.34	0.32	0.30	0.29	0.28
Met. + Cys. (%)	0.75	0.71	0.68	0.65	0.62
Dig. Met.+Cys. (%)	0.62	0.59	0.56	0.53	0.51
Arginine (%)	0.86	0.82	0.78	0.74	0.71
Dig. Arginine (%)	0.71	0.67	0.64	0.61	0.58
Valine (%)	0.70	0.67	0.63	0.60	0.58
Dig. Valine (%)	0.60	0.57	0.54	0.51	0.49
Tryptophan (%)	0.18	0.17	0.17	0.16	0.15
Dig. Tryptophane (%)	0.15	0.14	0.14	0.13	0.12
Threonin (%)	0.59	0.56	0.53	0.50	0.48
Dig. Threonine (%)	0.48	0.46	0.43	0.41	0.39
Isoleucine (%)	0.67	0.64	0.60	0.57	0.55
Dig. Isoleucine (%)	0.55	0.52	0.50	0.47	0.45
Linoleic acid (%)	1.11	1.05	1.00	0.95	0.91

* A nutritionist should be consulted if the energy levels above 1370 or below 1240 kcal/lb (2980 or below 2755kcal/kg)
** Without Phytase

Table 22: Supply of Fine and Coarse Limestone

Feedtype	Fine Limestone	Coarse Limestone
Layer Phase 1	40 %	60 %
Layer Phase 2	30 %	70 %
Layer Phase 3	30 %	70 %
Layer Phase 4 + 5	30 %	70 %

Feed Quality

Always maintain high feed quality. The basics include proper sampling of feed ingredients and mixed feed and the chemical analysis of those samples.

Feed Restriction in the Lay Cycle

H&N Nick Chicks are not normally prone to put on fat with correctly formulated feeds. Therefore, feed restriction is seldom recommended during the lay period. If a restriction program is used, watch egg size, body weight and percent production very closely. These traits will decline first if birds are being under fed.

Energy Requirement

The energy requirement of adult laying birds depends upon several factors, such as growth, maintenance, production and environmental temperatures. Under normal conditions layers eat mainly to satisfy their energy requirement. In order to maintain an optimal and persistent performance throughout the whole laying cycle do not reduce the energy level below 1240 kcal / lb (2755 kcal / kg = 11.4 MJ / kg).

Calcium

Laying hens need adequate calcium in their diets for eggshell formation. Layers will have more available calcium if the dietary calcium sources are in two different forms. One form may be finely ground such as limestone. The other should be fed as large particle size such as oyster shell or hen-size limestone.

The bird's system is not as efficient at utilizing calcium sources after 40 weeks of age. Also, older flocks produce larger eggs and more calcium is needed to produce a strong shell on these bigger eggs. For these reasons higher levels of calcium should be formulated into the diet as the flock ages.

Available Phosphorus

There is little change in the available phosphorus requirements during the life of the flock. Be careful to provide only the level of available phosphorus intake necessary (about a half gram per bird per day). Too little or too much available phosphorus consumption can lead to shell quality problems. There is considerable research that indicates that available phosphorus intake as low as 350 mg at the end of the production cycle will improve shell quality but there is a great risk of accidentally feeding less than 350 mg; therefore, this low level is not recommended.

Post-Peak Body Weights, Production and Egg Weight

Body weight change, especially early in lay, is an indicator of proper or improper nutrient intake and should be considered as a part of the feeding program of the layer. At the start of egg production hens' bodies are not fully developed. The growth curve will continue and only flatten after 25 to 30 weeks of age when weekly body weight gain stays lower. Pullets must not lose weight after being transferred. They should continue to gain weight, or at least maintain their body weight. If body weight does not increase slightly, production and egg weight may suffer. After a flock is 36 weeks old, the body weight average should be relatively stable with only a very gradual increase. A slight gain in body weight indicates that sufficient nutrients are being consumed for maximum performance.

Excessive gains indicate excess amounts of nutrients. Adjust nutrient intake if excessive weight gain is present. If the body weight average should drop, the cause should be found immediately to avoid losses in production and egg mass.

If the above management recommendations are followed, "Nick Chick" flocks should obtain the performance in Table 27.

Table 23: Recommended Daily Nutrient Intake per Bird

Age in Weeks	Feed Consumption		ME kcal/bird/day	C. Protein g/bird/day	Methionine mg/bird/day	TSAA mg/bird/day	Lysine mg/bird/day	Calcium g/bird/day	Av. Phosphorus mg/bird/day
	g/bird/day	lbs/100/day							
20	88	19.4	231	14.0	343	630	700	3.00	345
21	93	20.5	245	15.0	368	675	750	3.50	403
22	98	21.6	259	16.3	395	725	806	3.80	437
23	102	22.5	273	17.1	434	797	885	4.05	466
24	105	23.2	287	17.7	449	824	916	4.15	477
25	107	23.6	304	18.2	459	843	937	4.20	483
26	108	23.8	304	18.5	459	843	936	4.22	485
27	108	23.8	304	18.6	460	845	938	4.23	486
28	108	23.8	304	18.6	456	837	930	4.24	487
29	108	23.8	304	18.5	456	837	930	4.25	488
30	108	23.8	304	18.5	455	836	929	4.25	489
31	108	23.8	304	18.5	456	838	931	4.26	490
32	108	23.8	304	18.5	458	840	934	4.27	489
33	108	23.8	304	18.4	458	841	934	4.28	487
34	108	23.8	304	18.4	458	841	935	4.29	485
35	108	23.8	304	18.4	457	840	933	4.29	483
36	108	23.8	304	18.4	457	839	932	4.30	481
37	108	23.8	304	18.3	456	837	930	4.31	479
38	108	23.8	304	18.3	456	837	930	4.32	477
39	108	23.8	304	18.3	454	834	927	4.33	475
40	108	23.8	304	18.3	453	833	925	4.33	473
41	108	23.8	304	18.2	452	830	922	4.34	471
42	109	24.0	307	18.2	451	828	920	4.35	469
43	109	24.0	307	18.2	449	826	917	4.36	467
44	109	24.0	307	18.1	449	824	916	4.37	465
45	109	24.0	307	18.1	447	821	912	4.37	463
46	109	24.0	307	18.1	446	819	910	4.38	460
47	109	24.0	307	18.1	444	816	907	4.39	458
48	109	24.0	307	18.0	443	814	905	4.40	455
49	109	24.0	307	18.0	442	811	901	4.41	453
50	109	24.0	307	18.0	441	809	899	4.41	450
51	109	24.0	307	17.9	439	806	895	4.42	448
52	109	24.0	307	17.9	438	804	893	4.43	445

Table 23: Recommended Daily Nutrient Intake per Bird

Age in Weeks	Feed Consumption		ME kcal/bird/day	C. Protein g/bird/day	Methionine mg/bird/day	TSAA mg/bird/day	Lysine mg/bird/day	Calcium g/bird/day	Av. Phosphorus mg/bird/day
	g/bird/day	lbs/100/day							
53	109	24.0	307	17.9	436	801	890	4.44	443
54	109	24.0	307	17.8	435	799	888	4.45	440
55	109	24.0	307	17.8	433	796	885	4.45	438
56	108	23.8	307	17.8	432	794	882	4.46	435
57	108	23.8	307	17.8	431	792	880	4.47	433
58	108	23.8	307	17,7	430	789	877	4,48	430
59	108	23.8	307	17,7	428	787	874	4,49	428
60	108	23.8	307	17,7	427	785	872	4,49	425
61	108	23.8	307	17,6	426	782	869	4,50	423
62	108	23.8	307	17,6	424	779	866	4,51	420
63	108	23.8	307	17,5	422	776	862	4,52	418
64	108	23.8	307	17,5	421	773	859	4,53	415
65	108	23.8	307	17,5	419	770	855	4,53	413
66	108	23.8	307	17,4	418	767	853	4,54	410
67	108	23.8	307	17,4	417	766	851	4,55	408
68	108	23.8	307	17,3	416	765	850	4,56	405
69	108	23.8	307	17,3	415	763	848	4,57	403
70	108	23.8	307	17,3	414	760	845	4,57	400
71	108	23.8	307	17,2	412	757	841	4,58	398
72	107	23.6	307	17,2	410	753	837	4,59	395
73	107	23.6	307	17,1	408	749	833	4,60	393
74	107	23.6	307	17,1	406	745	828	4,61	390
75	107	23.6	307	17,1	404	742	824	4,61	388
76	107	23.6	307	17,0	402	739	821	4,62	385
77	107	23.6	307	17,0	401	736	817	4,63	383
78	107	23.6	307	16,9	399	733	814	4,64	380
79	107	23.6	307	16,9	397	730	811	4,65	378
80	107	23.6	307	16,9	396	727	807	4,65	375
81	107	23.6	307	16,8	394	723	804	4,66	373
82	107	23.6	307	16,8	393	721	801	4,67	370
83	107	23.6	307	16,7	391	719	799	4,68	368
84	107	23.6	307	16,7	390	717	796	4,69	365
85	107	23.6	307	16,7	389	715	794	4,70	363

Table 24: Feed Ingredients (Source: Feedstuffs, 2014)

	Dry Matter	Crude Protein	Ether Extract	Crude Fiber	Calcium	Total Phosphorus	Available[7] Phosphorus	Ash	Ruminant digestible Protein	Ruminant TDN	– Poultry ME[6] –		– Swine ME[6] –	
INGREDIENTS[2]	%	%	%	%	%	%	%	%	%	%	kcal/lb.	kcal/kg	kcal/lb.	kcal/kg
Alfalfa meal, dehy	93	20.0	3.5	20.0	1.50	0.27	0.27	10.5	14.0	58	740	1630	1070	2350
Alfalfa meal, dehy	93	17.0	3.0	24.0	1.30	0.23	0.23	9.6	12.3	58	672	1480	1020	2250
Alfalfa meal, dehy	93	15.0	2.3	26.0	1.20	0.22	0.22	8.5	11.0	57	600	1320	945	2075
Alfalfa meal, suncured	91	15.0	1.7	29.0	1.40	0.20	0.20	9.0	11.0	55	350	770	790	1740
Bakery meal	91	10.0	10.0	3.0	0.10	0.25	0.18	4.0	6.0	82	1550	3417	1585	3494
Bakery meal, low ash/fiber	91	10.0	11.5	1.5	0.10	0.25	0.18	2.0	6.0	82	1750	3858	1800	3960
Barley, grain	89	11.5	1.9	5.0	0.08	0.42	0.15	2.5	8.6	74	1250	2750	1305	2870
Barley, grain, Western	91	10.6	2.2	6.3	0.04	0.35	0.12	2.7	6.4	73	1255	2760	1315	2900
Barley, malt, eehy	91	13.7	1.9	3.3	0.06	0.46	—	2.2	9.0	72	n/a	n/a	1490	3280
Beans, broad (vicia faba)	89	25.7	1.4	8.2	0.14	0.54	0.20	6.0	21.6	72	1100	2420	n/a	n/a
Beet pulp, dried	91	8.0	0.5	21.0	0.60	0.10	—	3.8	4.3	68	300	660	1065	2345
Blood meal, animal	89	80.0	1.0	1.0	0.28	0.22	0.22	4.4	63.1	60	1465	3220	875	1925
Brewers dried grain	93	27.9	7.4	11.7	0.30	0.66	0.20	4.8	19.1	73	1020	2245	850	1870
Brewers dried yeast	93	45.0	0.4	1.5	0.10	1.40	0.45	6.5	41.6	73	1130	2485	1205	2650
Buckwheat, grain	88	11.0	2.5	11.0	0.10	0.30	0.10	2.1	7.6	69	1200	2640	1285	2830
Buttermilk, dried	89	2.0	5.0	0.3	1.30	0.90	0.90	10.0	25.3	84	1250	2750	1370	3010
Camelina meal	90	33.9	12.0	12.4	0.33	0.94	—	5.8	—	—	1510	3328	n/a	n/a
Canola meal	91	38.0	3.8	11.1	0.68	1.20	0.40	7.2	32.0	64	960	2110	1180	2600
Casein, dried	90	80.0	0.5	0.2	0.60	1.00	1.00	3.5	76.0	74	1875	4120	1245	2740
Cassava tubers, meal	87	2.4	0.3	7.6	0.15	0.08	—	3.0	—	68	1325	2915	1510	3320
Cattle manure, dried	90	16.6	—	—	1.60	0.75	—	7.6	n/a	n/a	n/a	n/a	n/a	n/a
Citrus pulp, dried	91	6.0	3.7	12.2	1.40	0.10	—	4.6	3.0	74	600	1320	850	1875
Coconut meal, mech.	93	22.0	6.0	12.0	0.17	0.60	—	7.0	18.0	77	690	1520	1135	2500
Corn, yellow, grain	86	7.5	3.5	1.9	0.01	0.28	0.12	1.1	5.8	80	1530	3373	1520	3350
Corn, high oil, grain	87	8.4	6.0	2.0	0.01	0.26	0.09	1.2	n/a	85	1615	3560	1595	3520
Corn, dent, yellow, ears ground	88	7.5	3.0	10.0	0.04	0.20	0.07	1.5	4.3	73	1290	2840	1135	2500
Corn cobs, meal	89	2.3	0.4	35.0	0.11	0.04	—	1.5	1.8	42	240	528	140	305
Corn germ meal, wet milled	90	20.0	1.0	12.0	0.30	0.50	0.15	3.8	19.3	70	770	1700	1320	2900
Corn germ meal, dry milled	91	17.7	0.9	10.9	0.03	0.50	0.15	3.5	n/a	69	n/a	n/a	1190	2615
Corn gluten feed	88	21.0	2.0	10.0	0.20	0.90	0.22	7.8	19.3	75	795	1750	1090	2400
Corn gluten meal, 41%	90	42.0	2.0	4.0	0.16	0.40	0.25	3.0	35.7	76	1510	3310	1395	3070
Corn gluten meal, 60%	90	60.0	2.0	2.5	0.02	0.50	0.18	1.8	47.4	86	1700	3740	n/a	n/a
Cottonseed meal, 41%, pre-press solvent	90	41.0	1.5	12.7	0.17	1.00	0.32	6.4	30.6	71	880	1940	1200	2640
Cottonseed meal, 41%, mech. Extd	91	41.0	3.9	12.6	0.17	0.97	0.32	6.2	32.9	71	955	2100	1345	2955
Cottonseed meal, 41%, direct solvent	90	41.0	2.1	11.3	0.16	1.00	0.32	6.4	29.5	72	915	2010	1225	2690
Cottonseed hulls	90	4.0	4.4	43.0	0.14	0.09	—	2.5	3.2	47	n/a	n/a	n/a	n/a
Cottonseed, whole seeds with lint	92	23.0	19.0	26.0	0.19	0.61	n/a	4.4	19.0	96	n/a	n/a	n/a	n/a
Crab meal	95	30.0	2.2	10.5	18.00	1.50	1.50	31.0	24.9	27	675	1485	n/a	n/a
Distillers dried grains w/solubles (Beverage)	91	29.0	8.4	7.8	0.27	0.78	0.35	4.3	20.0	78	1090	2400	1485	3270
Distillers dried grains, corn	92	27.0	9.0	13.0	0.09	0.41	0.17	2.2	19.3	79	910	2000	1460	3210
Distillers dried grains w/solubles ("Normal oil"), corn	92	27.0	9.0	8.5	0.14	0.86	0.55	4.5	21.1	82	1245	2744	1497	3300
Distillers dried grains w/solubles ("Low oil"), corn	88	29.0	7.0	7.0	0.10	0.87	0.52	5.5	—	—	1150	2530	1410	3108
Distillers dried solubles, corn	92	27.0	9.0	4.0	0.35	1.30	1.20	8.2	22.8	78	1275	2810	1500	3300
Fat, animal	99	0.0	98.0	—	—	—	—	—	—	200	3600	7920	3615	7950
Fat, poultry	99	0.0	98.0	—	—	—	—	—	—	—	3800	8377	3820	8422
Fat, yellow grease	99	0.0	98.0	—	—	—	—	—	—	—	3750	8250	3750	8250
Fat, vegetable	99	0.0	99.0	—	—	—	—	—	—	—	4000	8800	3955	8700
Feather meal, poultry	93	85.0	4.0	1.5	0.20	0.70	0.70	3.9	70.1	63	1310	2880	1030	2270
Fish meal. AAFCO	88	59.0	5.6	1.0	5.50	3.30	3.30	20.2	n/a	59	1080	2600	1125	2480
Fish meal, herring, Atlantic	93	72.0	10.0	1.0	2.00	1.00	1.00	10.4	56.6	73	1450	3190	1420	3130
Fish meal, menhaden	92	62.0	9.2	1.0	4.80	3.00	3.00	19.0	48.6	71	1340	2950	1460	3220
Fish meal, anchovy, Peruvian	91	65.0	10.0	1.0	4.00	2.85	2.85	15.0	52.7	73	1280	2820	1340	2950
Fish meal, red fish	92	57.0	8.0	1.0	7.70	3.80	3.80	26.0	46.2	70	1350	2970	1160	2550
Fish meal, sardine	92	65.0	5.5	1.0	4.50	2.70	2.70	16.0	52.7	70	1300	2860	1160	2500
Fish meal, tuna	93	53.0	11.0	5.0	8.40	4.20	4.20	25.0	50.5	71	1150	2530	1150	2530
Fish meal, white	91	61.0	4.0	1.0	7.00	3.50	3.50	24.0	51.0	72	1180	2600	1120	2460
Fish meal, freshwater, Alewife	90	65.7	12.8	1.0	5.20	2.90	2.90	14.6	53.3	71	1560	3430	1565	3440
Fish solubles, condensed	51	31.0	4.0	0.5	0.10	0.50	0.50	10.0	41.3	42	905	1990	830	—
Fish solubles, dehy	93	40.0	6.0	5.5	0.40	1.20	1.20	12.5	n/a	76	1580	3480	1335	2940
Flaxseed	92	22.0	34.0	6.5	0.25	0.50	—	—	—	—	1795	3957	n/a	n/a
Hominy feed, corn screw-pressed	89	10.5	6.5	5.0	0.05	0.50	0.17	3.0	8.0	86	1410	3108	1530	3365
Kafir grain sorghum	90	11.8	2.9	2.0	0.04	0.33	—	1.5	7.9	65	1550	3410	1315	2895
Kelp meal, dehy	91	8.9	1.6	3.9	1.20	0.16	—	17.3	7.3	29	n/a	n/a	n/a	n/a

[1] n/a= Data Not Available [2] Data listed are intended to represent the ingredients shown. Due to factors that can infl uence individual lots, no guarantee is made that such lots will compare with the analysis in this table. [3] ppm= parts per million [4] A dash (—) indicates that the ingredient does not contain a signifi cant amount of that item. [5] All table data are basis "as fed" [6] ME = Metabolizable Energy [7] Available phosphorus values were determined in chicks unless otherwise noted [8] True Amino acid availability coeffi ceints were determined with cecectomized roosters

Table 24: Feed Ingredients (Source: Feedstuffs, 2014)

	AMINO ACIDS (Percent availability in parenthesis)[8]										
	Methioine	Cysteine	Lysine	Tryptohan	Threonine	Isoleucine	Histidine	Valine	Leucine	Arginine	Phenyl-alanine
INGREDIENTS[2]	%	%	%	%	%	%	%	%	%	%	%
Alfalfa meal, dehy	0.33	0.23	0.87	0.46	0.88	0.98	0.42	1.19	1.50	0.98	1.04
Alfalfa meal, dehy	0.28 (73)	0.18 (40)	0.73 (59)	0.45	0.75 (71)	0.84 (77)	0.35 (74)	1.04 (75)	1.3 (80)	0.75 (82)	0.91 (78)
Alfalfa meal, dehy	0.23	0.17	0.60	0.38	0.60	0.68	0.30	0.84	1.10	0.58	0.66
Alfalfa meal, suncured	0.20	0.17	0.60	0.38	0.60	0.60	0.22	0.60	1.10	0.58	0.58
Bakery meal	0.16 (85)	0.16 (80)	0.3 (64)	0.09	0.28 (72)	0.36 (84)	0.2 (82)	0.4 (81)	0.8 (86)	0.4 (84)	0.4 (86)
Bakery meal, low ash/fiber	0.16	0.16	0.30	0.09	0.28	0.36	0.20	0.40	0.80	0.40	0.40
Barley, grain	0.18 (79)	0.25 (81)	0.53 (78)	0.17	0.36 (77)	0.42 (82)	0.23 (87)	0.62 (81)	0.8 (86)	0.5 (85)	0.62 (88)
Barley, grain, Western	0.18	0.22	0.39	0.15	0.29	0.40	0.30	0.46	0.70	0.45	0.47
Barley, malt, eehy	0.20	n/a	0.50	0.20	0.40	0.60	0.30	0.70	0.70	0.40	0.60
Beans, broad (vicia faba)	0.25	0.14	1.52	0.24	0.98	1.00	0.60	1.22	1.60	2.20	0.98
Beet pulp, dried	0.01	0.01	0.60	0.10	0.40	0.30	0.20	0.40	0.60	0.30	0.30
Blood meal, animal	1.0 (91)	1.4 (76)	6.9 (86)	1.00	3.8 (87)	0.8 (78)	3.05 (84)	5.2 (87)	10.3 (89)	2.35 (87)	5.1 (88)
Brewers dried grain	0.60	0.40	0.90	0.40	1.00	2.00	0.47	1.69	3.20	1.30	1.82
Brewers dried yeast	1.00	0.50	3.40	0.80	2.50	2.20	1.30	2.37	3.20	2.20	1.86
Buckwheat, grain	0.18	0.20	0.60	0.18	0.44	0.35	0.26	0.53	0.53	0.80	0.44
Buttermilk, dried	0.70	0.38	2.40	0.50	1.60	2.70	0.90	2.80	3.40	1.10	1.50
Camelina meal	0.61 (92)	0.66 (85)	1.54 (86)	0.42 (93)	1.30 (84)	1.20 (89)	0.75 (91)	1.61 (88)	2.13 (91)	2.62 (94)	1.40 (92)
Canola meal	0.77 (90)	0.97 (73)	2.02 (79)	0.46 (82)	1.50 (78)	1.51 (83)	1.10 (85)	1.94 (82)	2.6 (87)	2.3 (90)	1.5 (87)
Casein, dried	2.7 (99)	0.3 (84)	7.0 (97)	1.00	3.8 (98)	5.7 (98)	2.5 (96)	6.8 (98)	8.7 (99)	3.4 (97)	4.6 (99)
Cassava tubers, meal	—	—	—	—	—	—	—	—	n/a	—	—
Cattle manure, dried	0.06	—	0.33	n/a	0.21	0.21	0.09	0.29	n/a	0.14	0.06
Citrus pulp, dried	0.08	0.11	0.20	0.06	n/a	n/a	n/a	n/a	n/a	0.28	n/a
Coconut meal, mech.	0.33 (83)	0.2 (48)	0.54 (58)	0.20	0.6 (58)	1.0 (78)	0.3 (69)	1.0 (78)	1.49 (80)	2.3 (85)	0.8 (84)
Corn, yellow, grain	0.18 (91)	0.18 (85)	0.24 (81)	0.07 (90)	0.29 (84)	0.29 (88)	0.25 (94)	0.42 (88)	1.0 (93)	0.4 (89)	0.42 (91)
Corn, high oil, grain	0.20	0.19	0.28	0.07	0.31	0.31	0.27	0.42	1.06	0.43	0.42
Corn, dent, yellow, ears ground	0.14	0.13	0.16	0.05	n/a	n/a	n/a	n/a	1.00	0.30	n/a
Corn cobs, meal	—	—	—	—	—	—	—	—	—	—	—
Corn germ meal, wet milled	0.60	0.40	0.90	0.20	1.10	0.70	0.70	1.20	1.70	1.30	0.90
Corn germ meal, dry milled	0.43	0.40	1.10	0.25	0.90	0.60	0.60	1.10	1.30	1.40	0.90
Corn gluten feed	0.5 (84)	0.5 (65)	0.6 (72)	0.10	0.9 (75)	0.6 (81)	0.7 (82)	1.04 (83)	1.9 (89)	1.0 (87)	0.8 (87)
Corn gluten meal, 41%	1.00	0.60	0.80	0.20	1.40	2.30	0.90	2.20	6.60	1.40	2.90
Corn gluten meal, 60%	1.9 (97)	1.1 (86)	1.0 (88)	0.30	2.0 (92)	2.3 (95)	1.2 (94)	2.70 (95)	9.4 (98)	1.9 (96)	3.8 (97)
Cottonseed meal, 41%, pre-press solvent	0.52 (73)	0.64 (73)	1.65 (67)	0.47	1.32 (71)	1.33 (75)	1.1 (69)	1.88 (78)	2.4 (77)	4.59 (87)	2.22 (86)
Cottonseed meal, 41%, mech. Extd	0.55	0.59	1.52	0.50	1.30	1.31	1.07	1.84	2.50	4.33	2.20
Cottonseed meal, 41%, direct solvent	0.51	0.62	1.70	0.52	1.34	1.33	1.10	1.82	2.40	4.66	2.23
Cottonseed hulls	—	—	—	—	—	—	—	—	—	—	—
Cottonseed, whole seeds with lint	0.40	0.41	1.02	0.30	0.81	0.75	0.73	1.10	0.75	2.71	1.25
Crab meal	0.50	0.20	1.40	0.30	1.20	1.20	0.50	1.50	1.60	1.70	1.20
Distillers dried grains w/solubles (Beverage)	0.46	0.52	0.81	0.20	1.12	1.93	0.81	1.83	2.34	1.12	1.93
Distillers dried grains, corn	0.45	0.32	0.90	0.21	0.30	0.93	0.60	1.20	2.60	1.00	0.60
Distillers dried grains w/solubles (“Normal oil”), corn	0.51 (84)	0.5 (74)	0.8 (70)	0.2 (76)	0.92 (72)	1.0 (84)	0.65 (80)	1.33 (81)	2.8 (89)	1.1 (73)	1.2 (88)
Distillers dried grains w/solubles (“Low oil”), corn	0.57	0.63	0.94	0.21	1.06	0.97	0.74	1.48	2.96	1.29	1.40
Distillers dried solubles, corn	0.60	0.60	0.90	0.20	1.00	1.20	0.60	1.60	2.10	1.00	1.50
Fat, animal	—	—	—	—	—	—	—	—	—	—	—
Fat, poultry	—	—	—	—	—	—	—	—	—	—	—
Fat, yellow grease	—	—	—	—	—	—	—	—	—	—	—
Fat, vegetable	—	—	—	—	—	—	—	—	—	—	—
Feather meal, poultry	0.65 (76)	4.0 (59)	2.05 (66)	0.50	3.8 (73)	3.66 (85)	0.78 (72)	5.75 (82)	7.8 (82)	5.75 (83)	3.54 (85)
Fish meal. AAFCO	1.72	0.57	5.17	0.67	2.49	3.64	1.53	3.26	4.69	3.73	2.68
Fish meal, herring, Atlantic	2.20	0.72	5.70	0.80	2.88	3.00	1.91	5.70	5.10	5.64	2.56
Fish meal, menhaden	1.7 (92)	0.5 (73)	4.7 (88)	0.50	2.75 (98)	2.40 (92)	1.52 (92)	2.80 (91)	4.4 (92)	3.65 (92)	2.28
Fish meal, anchovy, Peruvian	1.90	0.60	4.90	0.75	2.70	3.00	1.50	3.40	5.00	3.38	2.39
Fish meal, red fish	1.80	0.40	6.60	0.60	2.60	3.50	1.30	3.33	4.90	4.10	2.50
Fish meal, sardine	2.00	0.80	5.90	0.50	2.60	3.30	1.80	3.40	3.80	2.70	2.00
Fish meal, tuna	1.50	0.40	3.90	0.71	2.50	2.40	1.80	2.80	3.80	3.20	2.50
Fish meal, white	1.65	0.75	4.30	0.70	2.60	3.10	1.93	3.25	4.50	4.20	2.80
Fish meal, freshwater, Alewife	1.93	0.47	5.49	0.63	3.29	3.40	1.93	3.58	4.80	4.69	2.91
Fish solubles, condensed	0.45	0.19	1.46	0.11	0.70	0.70	1.09	1.00	1.60	1.37	0.70
Fish solubles, dehy	0.64	0.50	2.60	2.30	1.10	1.20	0.90	1.60	2.60	1.80	1.30
Flaxseed	0.35	0.42	0.92	0.22	0.77	0.95	0.44	1.17	1.25	2.05	0.97
Hominy feed, corn screw-pressed	0.22	0.12	0.45	0.12	0.43	0.38	0.36	0.59	0.90	0.60	0.40
Kafir grain sorghum	0.18	0.14	0.27	0.18	0.45	0.54	0.27	0.63	1.60	0.35	0.63
Kelp meal, dehy	0.10	n/a	0.04	n/a	0.03	n/a	n/a	n/a	0.09	0.10	n/a

[1] n/a= Data Not Available [2] Data listed are intended to represent the ingredients shown. Due to factors that can infl uence individual lots, no guarantee is made that such lots will compare with the analysis in this table. [3] ppm= parts per million [4] A dash (—) indicates that the ingredient does not contain a signifi cant amount of that item. [5] All table data are basis “as fed” [6] ME = Metabolizable Energy [7] Available phosphorus values were determined in chicks unless otherwise noted [8] True Amino acid availability coeffi ceints were determined with cecectomized roosters

Table 24: Feed Ingredients (Source: Feedstuffs, 2014)

	VITAMINS										
	Carotene	Vitamin A	Vitamin E	Thiamin	Riboflavin	Pantothenic Acid	Biotin	Folic Acid	Choline	Vitamin B12	Niacin
INGREDIENTS[2]	mg/kg	IU/g	mg/kg	mg/kg	mg/kg	mg/kg	ug/kg	ug/kg	mg/kg	ug/kg	mg/kg
Alfalfa meal, dehy	123	248.0	147.0	3.90	15.50	32.6	300	2600	1614	—[4]	54.6
Alfalfa meal, dehy	110	123.0	128.0	3.50	12.30	29.9	270	2000	1515	—	45.7
Alfalfa meal, dehy	63	100.0	98.0	3.00	10.60	20.8	250	1540	1548	—	41.8
Alfalfa meal, suncured	45	6.0	40.0	2.80	8.70	15.3	250	1300	1500	—	35.3
Bakery meal	5	3.9	25.0	1.50	1.50	14.5	n/a	150	1230	n/a[1]	18.0
Bakery meal, low ash/fiber	5	3.9	25.0	1.50	1.50	14.5	n/a	150	1230	n/a	18.0
Barley, grain	—	—	36.0	5.00	2.00	6.4	200	397	1027	—	57.2
Barley, grain, Western	—	—	36.0	4.00	1.30	7.3	150	300	930	—	44.0
Barley, malt, eehy	—	—	n/a	4.00	2.90	7.9	n/a	n/a	895	n/a	56.7
Beans, broad (vicia faba)	—	—	1.0	5.50	1.60	2.7	90	n/a	1670	—	22.4
Beet pulp, dried	0	0.4	—	0.22	1.10	0.8	n/a	n/a	800	—	19.8
Blood meal, animal	—	—	—	0.44	1.50	1.1	80	80	990	—	31.0
Brewers dried grain	—	—	65.1	0.70	1.50	8.6	80	220	2110	4.00	46.4
Brewers dried yeast	—	—	2.2	94.60	38.50	114.0	5000	9000	4800	—	479.0
Buckwheat, grain	—	—	—	3.30	10.60	11.0	n/a	n/a	440	—	18.0
Buttermilk, dried	—	—	—	3.70	31.00	29.7	290	400	1808	20.00	8.6
Camelina meal	—	—	—	—	—	—	—	—	—	—	—
Canola meal	—	—	—	5.20	3.70	9.5	900	2300	6700	—	159.5
Casein, dried	—	—	—	0.40	1.50	2.6	40	400	209	—	1.3
Cassava tubers, meal	—	—	—	—	—	—	—	—	—	—	—
Cattle manure, dried	—	—	—	—	—	n/a	n/a	n/a	n/a	—	n/a
Citrus pulp, dried	—	—	—	1.32	2.20	14.0	n/a	n/a	748	—	22.5
Coconut meal, mech.	—	—	—	0.66	3.30	6.1	n/a	n/a	1100	—	28.6
Corn, yellow, grain	2	1.7	22.0	2.60	1.10	3.9	80	116	1100	—	21.5
Corn, high oil, grain	n/a	1.9	28.0	2.50	n/a	4.5	n/a	112	n/a	—	25.0
Corn, dent, yellow, ears ground	2	2.0	—	—	0.80	4.4	n/a	n/a	350	—	15.8
Corn cobs, meal	1	1.0	—	—	1.10	3.8	n/a	n/a	n/a	—	7.3
Corn germ meal, wet milled	2	—	80.8	6.00	4.00	6.7	220	200	2000	—	41.8
Corn germ meal, dry milled	2	n/a	87.0	n/a	3.70	3.3	n/a	n/a	1936	n/a	42.0
Corn gluten feed	8	13.1	14.8	2.00	2.40	17.8	220	200	2420	—	75.0
Corn gluten meal, 41%	16	25.0	19.9	0.22	1.50	9.6	150	220	330	—	54.5
Corn gluten meal, 60%	44	60.0	25.5	0.28	2.20	2.9	220	230	2200	—	81.0
Cottonseed meal, 41%, pre-press solvent	—	—	15.0	3.30	4.00	7.0	550	2662	2933	—	40.3
Cottonseed meal, 41%, mech. Extd	—	—	15.0	9.70	4.20	7.7	528	2728	2807	—	37.8
Cottonseed meal, 41%, direct solvent	—	—	15.0	7.70	4.40	9.9	550	2794	2706	—	39.2
Cottonseed hulls	—	—	—	—	3.70	—	—	—	—	—	—
Cottonseed, whole seeds with lint	—	—	—	—	—	—	—	—	—	—	—
Crab meal	—	—	—	—	7.50	6.6	n/a	n/a	2024	448.00	44.0
Distillers dried grains w/solubles (Beverage)	—	—	n/a	4.00	9.60	12.3	400	880	4005	n/a	81.3
Distillers dried grains, corn	2	3.1	30.5	1.60	2.80	5.9	400	—	1850	—	42.2
Distillers dried grains w/solubles ("Normal oil"), corn	4	2.7	40.0	3.50	9.00	11.4	300	880	3400	—	79.9
Distillers dried grains w/solubles ("Low oil"), corn	—	—	—	—	—	—	—	—	—	—	—
Distillers dried solubles, corn	—	1.2	55.8	5.90	11.40	21.8	1100	1100	4818	—	120.0
Fat, animal	—	—	7.9	—	—	—	—	—	—	—	—
Fat, poultry	—	—	—	—	—	—	—	—	—	—	—
Fat, yellow grease	—	—	—	—	—	—	—	—	—	—	—
Fat, vegetable	—	—	56.8	—	—	—	—	—	—	—	—
Feather meal, poultry	—	—	—	—	2.00	11.0	44	220	880	70.00	30.8
Fish meal. AAFCO	—	—	18.5	1.30	6.50	8.7	n/a	n/a	3510	250.00	60.8
Fish meal, herring, Atlantic	—	—	16.8	0.10	8.70	21.7	200	520	5240	588.00	141.6
Fish meal, menhaden	—	—	5.7	0.20	4.80	8.8	150	1000	3080	150.00	55.0
Fish meal, anchovy, Peruvian	—	—	5.6	0.10	7.50	20.3	200	220	5100	600.00	135.0
Fish meal, red fish	—	—	5.6	1.50	7.00	8.4	200	n/a	3429	n/a	35.0
Fish meal, sardine	—	—	5.6	0.08	4.40	14.3	100	n/a	3880	300.00	100.0
Fish meal, tuna	—	—	5.6	n/a	8.80	8.8	n/a	n/a	3050	143.00	65.0
Fish meal, white	—	—	5.6	1.51	4.60	4.7	n/a	n/a	4050	71.00	38.0
Fish meal, freshwater, Alewife	—	—	5.6	0.10	3.70	10.0	n/a	n/a	4230	284.00	34.0
Fish solubles, condensed	—	2.2	—	5.50	14.50	35.4	200	n/a	4028	350.00	169.0
Fish solubles, dehy	—	—	—	6.80	16.50	48.4	490	726	3960	308.00	209.0
Flaxseed	—	—	18.9	7.00	4.50	—	—	—	3150	—	41.0
Hominy feed, corn screw-pressed	9	15.3	—	8.30	2.20	7.7	130	330	1500	—	49.7
Kafir grain sorghum	—	0.6	—	3.80	1.40	12.2	n/a	n/a	n/a	—	36.6
Kelp meal, dehy	86	66.0	150.0	1.00	5.00	7.0	100	100	275	0.00	23.0

[1] n/a= Data Not Available [2] Data listed are intended to represent the ingredients shown. Due to factors that can infl uence individual lots, no guarantee is made that such lots will compare with the analysis in this table. [3] ppm= parts per million [4] A dash (—) indicates that the ingredient does not contain a signifi cant amount of that item. [5] All table data are basis "as fed" [6] ME = Metabolizable Energy [7] Available phosphorus values were determined in chicks unless otherwise noted [8] True Amino acid availability coeffi ceints were determined with cecectomized roosters

Table 24: Feed Ingredients (Source: Feedstuffs, 2014)

	MINERALS									
	Sodium	Potassium	Chloride	Magnesium	Sulphur	Manganese	Iron	Copper	Zinc	Selenium
INGREDIENTS[2]	%	%	%	%	%	ppm[3]	ppm	ppm	ppm	ppm
Alfalfa meal, dehy	0.08	2.50	0.47	0.32	0.43	40.0	320.0	10.0	23.0	0.50
Alfalfa meal, dehy	0.08	2.40	0.47	0.26	0.21	35.0	400.0	10.0	21.0	0.60
Alfalfa meal, dehy	0.07	2.30	0.49	0.26	0.17	30.0	450.0	10.0	21.0	0.50
Alfalfa meal, suncured	0.06	2.10	0.49	0.22	0.17	30.0	410.0	10.0	20.0	0.50
Bakery meal	1.14	0.10	1.25	0.32	0.02	60.0	50.0	5.0	15.0	0.40
Bakery meal, low ash/fiber	1.14	0.10	1.25	0.32	0.02	60.0	50.0	5.0	15.0	0.40
Barley, grain	0.03	0.56	0.14	0.12	0.15	16.0	80.0	8.0	30.0	0.20
Barley, grain, Western	0.02	0.56	0.14	0.12	0.15	16.0	80.0	8.0	20.0	0.10
Barley, malt, eehy	0.08	0.43	n/a	0.18	n/a	19.0	60.0	6.0	40.0	n/a
Beans, broad (vicia faba)	0.08	1.20	0.04	0.13	n/a	8.0	65.0	4.0	42.0	n/a
Beet pulp, dried	0.19	0.21	n/a	0.27	0.20	35.0	300.0	13.0	1.0	n/a
Blood meal, animal	0.31	0.90	0.28	0.22	0.32	5.0	2500.0	10.0	300.0	n/a
Brewers dried grain	0.26	0.08	0.12	0.19	0.30	38.0	290.0	21.0	100.0	0.70
Brewers dried yeast	0.07	1.72	n/a	0.23	n/a	6.0	100.0	33.0	39.0	1.0-1.5
Buckwheat, grain	0.05	0.45	0.04	0.10	—	34.0	44.0	10.0	9.0	n/a
Buttermilk, dried	0.95	1.00	0.70	0.48	0.08	4.0	n/a	n/a	n/a	0.12
Camelina meal	0.10	1.24	—	0.40	—	45.0	n/a	9.0	85.0	—
Canola meal	—	1.29	n/a	0.60	1.00	54.0	175.0	8.0	65.0	1.00
Casein, dried	0.01	n/a	n/a	n/a	n/a	4.0	17.0	4.0	30.0	n/a
Cassava tubers, meal	n/a	0.23	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Cattle manure, dried	0.36	0.72	n/a	0.27	n/a	88.0	80.0	15.0	111.0	n/a
Citrus pulp, dried	0.10	1.00	n/a	0.12	0.07	6.0	100.0	6.0	10.0	n/a
Coconut meal, mech.	0.06	0.60	0.03	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Corn, yellow, grain	0.02	0.33	0.04	0.08	0.08	4.5	25.0	2.9	20.0	0.08
Corn, high oil, grain	0.01	0.31	0.05	0.09	0.08	6.0	28.0	4.0	19.0	0.90
Corn, dent, yellow, ears ground	n/a	0.53	n/a	0.13	0.19	n/a	n/a	n/a	n/a	0.08
Corn cobs, meal	n/a	0.76	n/a	0.06	0.42	6.0	210.0	7.0	n/a	0.08
Corn germ meal, wet milled	0.04	0.30	n/a	0.16	0.32	4.0	330.0	4.0	100.0	0.33
Corn germ meal, dry milled	0.04	0.30	n/a	0.10	0.30	17.0	320.0	13.0	75.0	n/a
Corn gluten feed	0.15	1.30	0.22	0.42	0.16	24.0	460.0	35.0	80.0	0.22
Corn gluten meal, 41%	0.10	0.03	0.08	0.05	0.60	7.0	400.0	28.0	—	1.00
Corn gluten meal, 60%	0.03	0.45	0.05	0.15	0.50	4.0	400.0	22.0	41.0	1.00
Cottonseed meal, 41%, pre-press solvent	0.04	1.22	0.04	0.40	0.21	20.0	110.0	18.0	62.0	0.30
Cottonseed meal, 41%, mech. Extd	0.04	1.20	0.04	0.42	0.40	22.0	100.0	17.0	60.0	0.30
Cottonseed meal, 41%, direct solvent	0.04	1.16	0.04	0.40	0.30	21.0	90.0	16.0	60.0	0.30
Cottonseed hulls	0.02	0.87	n/a	0.13	—	—	—	—	—	—
Cottonseed, whole seeds with lint	0.01	1.07	0.06	0.41	0.23	17.0	100.0	8.0	34.0	0.14
Crab meal	0.85	0.45	1.50	0.88	0.04	133.0	440.0	33.0	102.0	3.80
Distillers dried grains w/solubles (Beverage)	0.60	0.86	0.18	0.34	0.30	40.0	320.0	73.0	70.0	0.20
Distillers dried grains, corn	0.25	0.16	0.07	0.20	0.43	23.0	300.0	30.0	55.0	0.35
Distillers dried grains w/solubles ("Normal oil"), corn	0.20	1.00	0.17	0.42	0.30	30.0	300.0	50.0	85.0	0.35
Distillers dried grains w/solubles ("Low oil"), corn	0.16	1.15	0.17	0.30	—	14.0	106.0	53.0	67.0	0.25
Distillers dried solubles, corn	0.18	1.74	0.25	0.64	0.37	74.0	600.0	83.0	85.0	0.33
Fat, animal	—	—	—	—	—	—	—	—	—	—
Fat, poultry	—	—	—	—	—	—	—	—	—	—
Fat, yellow grease	—	—	—	—	—	—	—	—	—	—
Fat, vegetable	—	—	—	—	—	—	—	—	—	—
Feather meal, poultry	0.70	0.30	0.28	0.20	1.40	9.0	70.0	7.0	55.0	0.80
Fish meal. AAFCO	1.07	0.39	n/a	0.21	0.24	23.0	360.0	15.0	100.0	1.5-2.0
Fish meal, herring, Atlantic	0.73	1.50	0.90	0.18	0.62	5.0	110.0	5.0	100.0	2.00
Fish meal, menhaden	0.68	0.96	0.80	0.21	0.45	40.0	880.0	8.0	92.0	2.00
Fish meal, anchovy, Peruvian	0.88	0.90	0.60	0.27	0.54	9.0	226.0	9.0	100.0	2.70
Fish meal, red fish	0.10	0.30	n/a	0.15	0.45	8.0	280.0	8.0	88.0	1.80
Fish meal, sardine	0.18	0.30	n/a	0.10	0.30	25.0	300.0	20.0	105.0	1.80
Fish meal, tuna	0.70	0.40	n/a	0.30	n/a	10.0	650.0	6.0	240.0	4.00
Fish meal, white	0.97	1.10	0.50	0.22	n/a	10.0	80.0	8.0	80.0	1.50
Fish meal, freshwater, Alewife	0.24	0.60	n/a	0.15	n/a	20.0	620.0	18.0	100.0	1.70
Fish solubles, condensed	1.00	1.75	2.65	0.02	0.13	12.0	300.0	48.0	38.0	2.00
Fish solubles, dehy	0.40	2.50	n/a	0.27	0.45	10.0	948.0	20.0	76.0	2.70
Flaxseed	0.08	1.50	—	0.50	—	—	236.0	22.0	91.0	—
Hominy feed, corn screw-pressed	0.10	0.67	0.05	0.24	—	15.0	65.0	15.0	3.0	0.15
Kafir grain sorghum	n/a	0.34	n/a	0.15	0.16	16.0	100.0	6.0	n/a	0.5-1.0
Kelp meal, dehy	2.40	2.30	n/a	0.85	0.73	62.0	566.0	5.0	46.0	0.40

[1] n/a= Data Not Available [2] Data listed are intended to represent the ingredients shown. Due to factors that can infl uence individual lots, no guarantee is made that such lots will compare with the analysis in this table. [3] ppm= parts per million [4] A dash (—) indicates that the ingredient does not contain a signifi cant amount of that item. [5] All table data are basis "as fed" [6] ME = Metabolizable Energy [7] Available phosphorus values were determined in chicks unless otherwise noted [8] True Amino acid availability coeffi ceints were determined with cecectomized roosters

Water

Drinking water for laying hens should be of acceptable (potable) quality. Only sufficient water quality ensures adequate water and feed intake. Precise details concerning water quality can be found in the chapter "water" on page 29. All details provided are also valid for adult laying hens (see page 30).

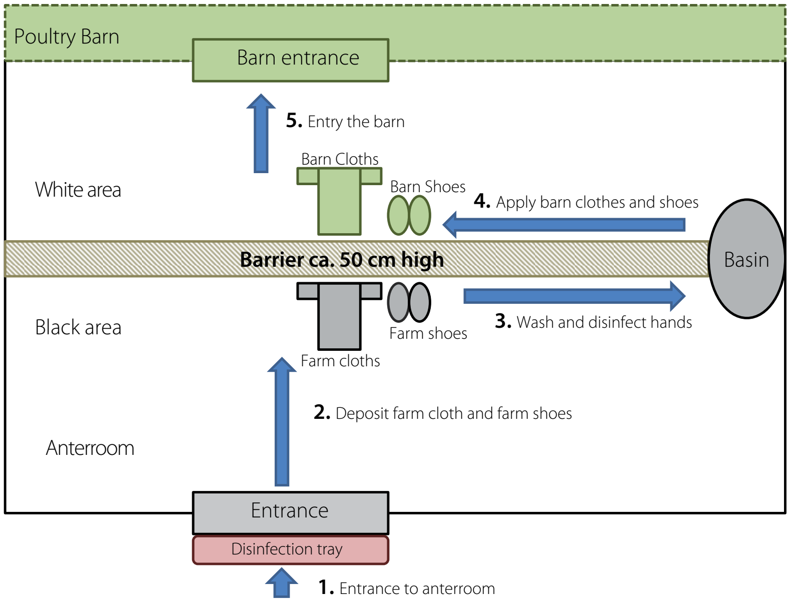
Cleaning and Disinfection

As soon as the hens have been moved out, it is advisable to treat walls and ceilings with insecticides while the building is still warm. All portable equipment (drinkers, feeders) should be taken outside. Litter and droppings must be disposed of. All litter must be removed and brought as far away from the building as possible (> 1 km or 0.6 mi.). Stabilising materials such as wood chips or similar should be removed from the outdoor area adjacent to the laying house and replaced at the same time as the litter. At least 24 hours prior to the cleaning operation (24 h), the entire interior of the building, including walls, ceilings and the remaining equipment, should be soaked. Fat and protein-dissolving substances should be used for this purpose. The room should then be cleaned with pressure washers, starting with the ceiling and working down towards the floor. Special attention should be paid to ventilation elements, pipework, edges and the tops of beams. The room should be well lit during the cleaning operation so that dirt deposits are clearly visible. After washing, all surfaces and equipment should be rinsed with clean water.

The equipment that was taken outside and the external walls of the building including any concrete surfaces should be washed down. Dirty drinkers are potential hazard sources and must therefore be cleaned and disinfected. Drinker lines should be thoroughly flushed out after disinfection. Disinfectant residues in drinkers should be avoided. Any traces of leftover feed should be removed from the farm. All parts of the feeding installation and the feed silo should be thoroughly cleaned, washed and disinfected.

Consult the manufacturer when choosing or combining disinfectants. Pathogenic agents can build up resistance. Therefore, a regular switch of active components is advisable.
Before entering a barn, clothes and shoes have to be changed. For this purpose, a simple personnel lock should be installed, which can be handled easily but not avoided (see figure 6 as example of a hygiene lock).
A possibility to wash and disinfect hands should be installed at all barn entrances.

Figure 6: Example of a simple Hygienic Sluice



PERFORMANCE IN THE LAY CYCLE

Laying Cycle Records

In order to evaluate performance and profitability, detailed laying cycle records are necessary. Daily figures for hen-day production, egg weight, feed and water consumption as well as mortality are necessary. This information will allow you to calculate very important data including daily egg mass, accumulative egg mass and feed conversion. All results should be graphed. Use of graphs will improve analyses of flock performance trends. As with growing records, accurate cage and / or pen counts are very important.

"Nick Chick" flocks, given proper nutrition and management, will continue to produce acceptable egg numbers and shell quality to at least 85 weeks of age. If circumstances indicate that force molting is advantageous, producers will find that "Nick Chick" flocks will perform very well after the molt.

Table 25: Expected Egg Grades (%) for different Egg Weights – within Production Weeks

Week	Egg Weight gram	Egg Weight Net. lbs / 30 Doz. Case	< 42 Pewee < 18 (Oz. / Doz.)	42 – 50 Small 18 – 21 (Oz. / Doz.)	50 – 57 Medium 21 – 24 (Oz. / Doz.)	57 – 64 Large 24 – 27 (Oz. / Doz.)	64 – 71 Extra Large 27 – 30 (Oz. / Doz.)	> 71 Jumbo > 30 (Oz. / Doz.)
20	42.0	33.3	50.0	49.7	0.3	0.0	0.0	0.0
21	46.0	36.5	10.7	78.6	10.6	0.1	0.0	0.0
22	49.0	38.9	2.1	59.3	36.5	2.1	0.0	0.0
23	50.9	40.4	0.6	39.3	52.5	7.5	0.0	0.0
24	52.3	41.5	0.3	26.5	57.5	15.7	0.1	0.0
25	53.5	42.5	0.1	16.8	58.2	24.8	0.1	0.0
26	54.5	43.3	0.1	12.1	53.0	34.2	0.7	0.0
27	55.3	43.9	0.0	8.7	48.4	41.6	1.3	0.0
28	56.1	44.5	0.0	6.1	42.9	48.7	2.2	0.0
29	56.7	45.0	0.0	4.4	38.4	54.1	3.1	0.0
30	57.3	45.5	0.0	3.5	33.9	57.7	4.8	0.0
31	57.8	45.9	0.0	2.6	30.0	61.2	6.1	0.0
32	58.3	46.3	0.0	2.1	26.7	62.9	8.2	0.1
33	58.8	46.7	0.0	1.6	23.1	65.2	10.0	0.1
34	59.2	47.0	0.0	1.3	20.8	65.4	12.2	0.2
35	59.5	47.2	0.0	1.0	18.5	67.0	13.3	0.2
36	59.8	47.5	0.0	0.9	17.1	66.3	15.3	0.3
37	60.1	47.7	0.0	0.8	15.7	65.7	17.3	0.5
38	60.3	47.9	0.0	0.8	14.8	65.3	18.6	0.6
39	60.4	47.9	0.0	0.7	14.4	65.0	19.2	0.6
40	60.6	48.1	0.0	0.6	13.0	65.5	20.3	0.6
41	60.7	48.2	0.0	0.6	12.7	65.1	21.0	0.7
42	60.9	48.3	0.0	0.5	12.0	64.2	22.5	0.9
43	61.0	48.4	0.0	0.5	11.6	63.8	23.2	1.0
44	61.2	48.6	0.0	0.5	10.9	62.9	24.6	1.1
45	61.3	48.7	0.0	0.4	10.5	62.4	25.3	1.2
46	61.5	48.8	0.0	0.3	9.4	62.4	26.8	1.1
47	61.6	48.9	0.0	0.3	9.1	61.8	27.5	1.3
48	61.7	49.0	0.0	0.3	8.8	61.2	28.2	1.4
49	61.9	49.1	0.0	0.3	8.3	60.0	29.6	1.8
50	62.0	49.2	0.0	0.3	8.1	59.4	30.4	1.9
51	62.1	49.3	0.0	0.3	7.8	58.8	31.1	2.1
52	62.3	49.4	0.0	0.2	7.3	57.6	32.5	2.4

Table 25: Expected Egg Grades (%) for different Egg Weights – within Production Weeks

Week	Egg Weight gram	Egg Weight Net. lbs / 30 Doz. Case	< 42 Pewee < 18 (Oz. / Doz.)	42 – 50 Small 18 – 21 (Oz. / Doz.)	50 – 57 Medium 21 – 24 (Oz. / Doz.)	57 – 64 Large 24 – 27 (Oz. / Doz.)	64 – 71 Extra Large 27 – 30 (Oz. / Doz.)	> 71 Jumbo > 30 (Oz. / Doz.)
53	62.4	49.5	0.0	0.2	7.0	56.9	33.2	2.5
54	62.5	49.6	0.0	0.2	6.8	56.3	34.0	2.7
55	62.6	49.7	0.0	0.2	6.2	56.1	35.0	2.5
56	62.8	49.8	0.0	0.2	5.8	54.7	36.3	3.0
57	62.9	49.9	0.0	0.2	5.7	54.0	36.9	3.2
58	63.0	50.0	0.0	0.2	5.5	53.3	37.6	3.5
59	63.1	50.1	0.0	0.2	5.3	52.6	38.2	3.7
60	63.2	50.2	0.0	0.1	5.1	51.9	38.9	4.0
61	63.3	50.2	0.0	0.1	4.9	51.2	39.5	4.2
62	63.3	50.2	0.0	0.1	4.9	51.2	39.5	4.2
63	63.4	50.3	0.0	0.1	4.7	50.5	40.2	4.5
64	63.4	50.3	0.0	0.1	4.7	50.5	40.2	4.5
65	63.5	50.4	0.0	0.1	4.3	49.9	41.5	4.2
66	63.5	50.4	0.0	0.1	4.3	49.9	41.5	4.2
67	63.6	50.5	0.0	0.1	4.1	49.2	42.0	4.5
68	63.6	50.5	0.0	0.1	4.1	49.2	42.0	4.5
69	63.6	50.5	0.0	0.1	4.1	49.2	42.0	4.5
70	63.7	50.6	0.0	0.1	4.0	48.5	42.5	4.9
71	63.7	50.6	0.0	0.1	4.0	48.5	42.5	4.9
72	63.7	50.6	0.0	0.1	4.0	48.5	42.5	4.9
73	63.7	50.6	0.0	0.1	4.0	48.5	42.5	4.9
74	63.7	50.6	0.0	0.1	4.0	48.5	42.5	4.9
75	63.8	50.6	0.0	0.1	3.9	47.7	43.1	5.2
76	63.8	50.6	0.0	0.1	3.9	47.7	43.1	5.2
77	63.8	50.6	0.0	0.1	3.9	47.7	43.1	5.2
78	63.8	50.6	0.0	0.1	3.9	47.7	43.1	5.2
79	63.8	50.6	0.0	0.1	3.9	47.7	43.1	5.2
80	63.9	50.7	0.0	0.1	3.8	47.0	43.6	5.6
81	63.9	50.7	0.0	0.1	3.8	47.0	43.6	5.6
82	63.9	50.7	0.0	0.1	3.8	47.0	43.6	5.6
83	63.9	50.7	0.0	0.1	3.8	47.0	43.6	5.6
84	63.9	50.7	0.0	0.1	3.8	47.0	43.6	5.6
85	64.0	50.8	0.0	0.1	3.6	46.3	44.1	5.9

Table 26: Expected Egg Grades (%) for different Egg Weights – Cumulative over Production Period

Week	Egg Weight gram	Egg Weight Net. lbs / 30 Doz. Case	< 42 Pewee < 18 (Oz. / Doz.)	42 – 50 Small 18 – 21 (Oz. / Doz.)	50 – 57 Medium 21 – 24 (Oz. / Doz.)	57 – 64 Large 24 – 27 (Oz. / Doz.)	64 – 71 Extra Large 27 – 30 (Oz. / Doz.)	> 71 Jumbo > 30 (Oz. / Doz.)
20	42.0	33.3	50.0	49.7	0.3	0.0	0.0	0.0
21	46.0	36.5	18.4	72.9	8.6	0.1	0.0	0.0
22	49.0	38.9	9.4	65.4	24.0	1.2	0.0	0.0
23	50.9	40.4	5.8	54.6	35.8	3.8	0.0	0.0
24	52.3	41.5	4.0	45.5	42.8	7.7	0.0	0.0
25	53.5	42.5	3.0	38.2	46.7	12.0	0.1	0.0
26	54.5	43.3	2.4	32.7	48.1	16.6	0.2	0.0
27	55.3	43.9	2.0	28.6	48.1	21.0	0.4	0.0
28	56.1	44.5	1.7	25.2	47.4	25.1	0.7	0.0
29	56.7	45.0	1.5	22.5	46.2	28.8	1.0	0.0
30	57.3	45.5	1.3	20.4	44.8	32.1	1.4	0.0
31	57.8	45.9	1.2	18.6	43.3	35.1	1.9	0.0
32	58.3	46.3	1.1	17.0	41.7	37.7	2.5	0.0
33	58.8	46.7	1.0	15.7	40.1	40.0	3.1	0.0
34	59.2	47.0	0.9	14.6	38.6	42.0	3.8	0.0
35	59.5	47.2	0.8	13.6	37.2	43.9	4.5	0.1
36	59.8	47.5	0.8	12.7	35.8	45.4	5.3	0.1
37	60.1	47.7	0.7	12.0	34.5	46.7	6.0	0.1
38	60.3	47.9	0.7	11.3	33.3	47.8	6.8	0.1
39	60.4	47.9	0.6	10.7	32.3	48.7	7.5	0.2
40	60.6	48.1	0.6	10.2	31.3	49.6	8.2	0.2
41	60.7	48.2	0.6	9.7	30.3	50.4	8.8	0.2
42	60.9	48.3	0.6	9.3	29.4	51.1	9.4	0.2
43	61.0	48.4	0.5	8.9	28.6	51.6	10.1	0.3
44	61.2	48.6	0.5	8.5	27.9	52.1	10.7	0.3
45	61.3	48.7	0.5	8.2	27.2	52.6	11.3	0.3
46	61.5	48.8	0.5	7.9	26.4	52.9	11.9	0.4
47	61.6	48.9	0.4	7.6	25.8	53.3	12.5	0.4
48	61.7	49.0	0.4	7.3	25.2	53.6	13.1	0.5
49	61.9	49.1	0.4	7.1	24.6	53.8	13.7	0.5
50	62.0	49.2	0.4	6.8	24.0	54.0	14.2	0.5
51	62.1	49.3	0.4	6.6	23.5	54.1	14.8	0.6
52	62.3	49.4	0.4	6.4	23.0	54.3	15.3	0.7

Table 26: Expected Egg Grades (%) for different Egg Weights – Cumulative over Production Period

Week	Egg Weight gram	Egg Weight Net. lbs / 30 Doz. Case	< 42 Pewee < 18 (Oz. / Doz.)	42 – 50 Small 18 – 21 (Oz. / Doz.)	50 – 57 Medium 21 – 24 (Oz. / Doz.)	57 – 64 Large 24 – 27 (Oz. / Doz.)	64 – 71 Extra Large 27 – 30 (Oz. / Doz.)	> 71 Jumbo > 30 (Oz. / Doz.)
53	62.4	49.5	0.4	6.2	22.5	54.3	15.9	0.7
54	62.5	49.6	0.4	6.0	22.0	54.4	16.4	0.8
55	62.6	49.7	0.3	5.9	21.6	54.4	17.0	0.8
56	62.8	49.8	0.3	5.7	21.1	54.5	17.5	0.9
57	62.9	49.9	0.3	5.6	20.7	54.4	18.0	0.9
58	63.0	50.0	0.3	5.4	20.3	54.4	18.5	1.0
59	63.1	50.1	0.3	5.3	19.9	54.4	19.0	1.1
60	63.2	50.2	0.3	5.2	19.6	54.3	19.5	1.1
61	63.3	50.2	0.3	5.1	19.2	54.2	20.0	1.2
62	63.3	50.2	0.3	4.9	18.9	54.2	20.4	1.3
63	63.4	50.3	0.3	4.8	18.6	54.1	20.9	1.4
64	63.4	50.3	0.3	4.7	18.3	54.0	21.3	1.4
65	63.5	50.4	0.3	4.6	18.0	53.9	21.7	1.5
66	63.5	50.4	0.3	4.5	17.7	53.8	22.1	1.5
67	63.6	50.5	0.3	4.5	17.5	53.7	22.5	1.6
68	63.6	50.5	0.3	4.4	17.2	53.7	22.9	1.7
69	63.6	50.5	0.2	4.3	17.0	53.6	23.2	1.7
70	63.7	50.6	0.2	4.2	16.7	53.5	23.6	1.8
71	63.7	50.6	0.2	4.1	16.5	53.4	23.9	1.8
72	63.7	50.6	0.2	4.1	16.3	53.3	24.3	1.9
73	63.7	50.6	0.2	4.0	16.1	53.2	24.6	1.9
74	63.7	50.6	0.2	3.9	15.9	53.1	24.9	2.0
75	63.8	50.6	0.2	3.9	15.7	53.1	25.1	2.0
76	63.8	50.6	0.2	3.8	15.5	53.0	25.4	2.1
77	63.8	50.6	0.2	3.8	15.3	52.9	25.7	2.1
78	63.8	50.6	0.2	3.7	15.1	52.8	26.0	2.2
79	63.8	50.6	0.2	3.7	15.0	52.7	26.2	2.2
80	63.9	50.7	0.2	3.6	14.8	52.7	26.4	2.3
81	63.9	50.7	0.2	3.6	14.7	52.6	26.7	2.3
82	63.9	50.7	0.2	3.5	14.5	52.5	26.9	2.3
83	63.9	50.7	0.2	3.5	14.4	52.4	27.1	2.4
84	63.9	50.7	0.2	3.4	14.3	52.4	27.3	2.4
85	64.0	50.8	0.2	3.4	14.1	52.3	27.5	2.5

Table 27: Performance of the Nick Chick Layer to 85 Weeks of Age

Age	Liveability	Number of Eggs	Rate of Lay H. D.	Body Weight		Feed		Egg Weight in Week			Egg Weight Cumulative			Egg Mass			
				in g	in lbs	Bird / Day in g	100 / Day in lbs	g	Oz. / Doz	Net. lbs / 30 Doz. Case	g	Oz./ Doz.	Net. lbs / 30 Doz. Case	g / HD in week	Oz. / Doz. HD in week	cum. kg / HH	cum. lbs / HH
20	100.0	0.7	10.0	1394	3.07	82	18.1	42.0	17.8	33.3	42.0	17.8	33.3	4.2	1.8	0.03	0.1
21	100.0	3.5	40.0	1439	3.17	87	19.2	46.0	19.5	36.5	45.2	19.1	35.9	18.4	7.8	0.16	0.3
22	99.9	7.7	60.0	1479	3.26	92	20.3	49.0	20.7	38.9	47.3	20.0	37.5	29.4	12.5	0.36	0.8
23	99.8	13.0	75.1	1514	3.34	97	21.4	50.9	21.5	40.4	48.7	20.6	38.7	38.2	16.2	0.63	1.4
24	99.8	18.9	85.2	1539	3.39	102	22.5	52.3	22.1	41.5	49.9	21.1	39.6	44.6	18.9	0.94	2.1
25	99.6	25.2	90.9	1559	3.44	108	23.8	53.5	22.6	42.5	50.8	21.5	40.3	48.6	20.6	1.28	2.8
26	99.5	31.7	93.0	1574	3.47	108	23.8	54.5	23.1	43.3	51.5	21.8	40.9	50.7	21.4	1.63	3.6
27	99.4	38.3	94.2	1584	3.49	108	23.8	55.3	23.4	43.9	52.2	22.1	41.4	52.1	22.0	2.00	4.4
28	99.3	44.8	94.4	1589	3.50	108	23.8	56.1	23.7	44.5	52.7	22.3	41.9	52.9	22.4	2.36	5.2
29	99.2	51.4	94.6	1594	3.51	108	23.8	56.7	24.0	45.0	53.3	22.5	42.3	53.6	22.7	2.74	6.0
30	99.1	58.0	94.7	1597	3.52	108	23.8	57.3	24.3	45.5	53.7	22.7	42.6	54.3	23.0	3.11	6.9
31	99.0	64.5	94.9	1600	3.53	108	23.8	57.8	24.5	45.9	54.1	22.9	43.0	54.9	23.2	3.49	7.7
32	98.9	71.1	95.1	1603	3.53	108	23.8	58.3	24.7	46.3	54.5	23.1	43.3	55.4	23.5	3.88	8.5
33	98.8	77.7	95.2	1606	3.54	108	23.8	58.8	24.9	46.6	54.9	23.2	43.6	55.9	23.7	4.26	9.4
34	98.7	84.3	95.3	1609	3.55	108	23.8	59.2	25.0	46.9	55.2	23.4	43.8	56.4	23.9	4.65	10.3
35	98.6	90.9	95.4	1612	3.55	108	23.8	59.5	25.2	47.2	55.5	23.5	44.1	56.8	24.0	5.05	11.1
36	98.5	97.5	95.5	1615	3.56	108	23.8	59.8	25.3	47.5	55.8	23.6	44.3	57.1	24.2	5.44	12.0
37	98.3	104.0	95.6	1618	3.57	108	23.8	60.1	25.4	47.7	56.1	23.7	44.5	57.4	24.3	5.83	12.9
38	98.2	110.6	95.7	1621	3.57	108	23.8	60.3	25.5	47.8	56.3	23.8	44.7	57.7	24.4	6.23	13.7
39	98.0	117.2	95.8	1624	3.58	108	23.8	60.4	25.6	47.9	56.6	23.9	44.9	57.9	24.5	6.63	14.6
40	97.9	123.8	95.9	1626	3.58	108	23.8	60.6	25.6	48.1	56.8	24.0	45.1	58.0	24.6	7.03	15.5
41	97.7	130.3	95.9	1628	3.59	108	23.8	60.7	25.7	48.2	57.0	24.1	45.2	58.2	24.6	7.42	16.4
42	97.6	136.9	96.0	1630	3.59	109	24.0	60.9	25.8	48.3	57.1	24.2	45.4	58.4	24.7	7.82	17.2
43	97.4	143.4	96.0	1632	3.60	109	24.0	61.0	25.8	48.4	57.3	24.3	45.5	58.6	24.8	8.22	18.1
44	97.3	150.0	96.0	1634	3.60	109	24.0	61.2	25.9	48.5	57.5	24.3	45.6	58.7	24.9	8.62	19.0
45	97.1	156.5	96.0	1636	3.61	109	24.0	61.3	25.9	48.7	57.7	24.4	45.8	58.8	24.9	9.02	19.9
46	97.0	163.0	95.9	1638	3.61	109	24.0	61.5	26.0	48.8	57.8	24.5	45.9	58.9	24.9	9.42	20.8
47	96.8	169.5	95.9	1640	3.62	109	24.0	61.6	26.1	48.9	57.9	24.5	46.0	59.0	25.0	9.82	21.7
48	96.7	176.0	95.8	1642	3.62	109	24.0	61.7	26.1	49.0	58.1	24.6	46.1	59.1	25.0	10.22	22.5
49	96.5	182.4	95.8	1644	3.62	109	24.0	61.9	26.2	49.1	58.2	24.6	46.2	59.2	25.1	10.62	23.4
50	96.4	188.9	95.7	1646	3.63	109	24.0	62.0	26.2	49.2	58.3	24.7	46.3	59.3	25.1	11.02	24.3
51	96.2	195.3	95.5	1648	3.63	109	24.0	62.1	26.3	49.3	58.5	24.8	46.4	59.3	25.1	11.42	25.2
52	96.1	201.7	95.4	1650	3.64	109	24.0	62.3	26.3	49.4	58.6	24.8	46.5	59.4	25.1	11.82	26.1

Table 27: Performance of the H&N "Nick Chick" Layer to 85 Weeks of Age

Age	Liveability	Number of Eggs	Rate of Lay H. D.	Body Weight		Feed		Egg Weight in Week			Egg Weight Cumulative			Egg Mass			
				in g	in lbs	Bird / Day in g	100 / Day in lbs	g	Oz. / Doz	Net. lbs / 30 Doz. Case	g	Oz./ Doz.	Net. lbs / 30 Doz. Case	g / HD in week	Oz./Doz. HD in week	cum. kg / HH	cum. lbs / HH
53	95.9	208.1	95.2	1652	3.64	109	24.0	62.4	26.4	49.5	58.7	24.9	46.6	59.4	25.1	12.22	26.9
54	95.8	214.5	95.0	1654	3.65	109	24.0	62.5	26.5	49.6	58.8	24.9	46.7	59.4	25.1	12.62	27.8
55	95.6	220.8	94.9	1656	3.65	109	24.0	62.6	26.5	49.7	58.9	24.9	46.8	59.4	25.2	13.02	28.7
56	95.5	227.2	94.6	1658	3.66	109	24.0	62.8	26.6	49.8	59.0	25.0	46.9	59.4	25.1	13.41	29.6
57	95.3	233.5	94.3	1660	3.66	109	24.0	62.9	26.6	49.9	59.1	25.0	46.9	59.3	25.1	13.81	30.4
58	95.2	239.7	94.1	1662	3.66	109	24.0	63.0	26.7	50.0	59.2	25.1	47.0	59.2	25.1	14.20	31.3
59	95.0	246.0	93.8	1664	3.67	109	24.0	63.1	26.7	50.1	59.3	25.1	47.1	59.1	25.0	14.60	32.2
60	94.9	252.2	93.5	1666	3.67	109	24.0	63.2	26.7	50.1	59.4	25.2	47.2	59.1	25.0	14.99	33.0
61	94.7	258.4	93.2	1668	3.68	109	24.0	63.3	26.8	50.2	59.5	25.2	47.2	59.0	25.0	15.38	33.9
62	94.6	264.5	92.9	1670	3.68	109	24.0	63.3	26.8	50.3	59.6	25.2	47.3	58.8	24.9	15.77	34.8
63	94.4	270.6	92.5	1672	3.69	109	24.0	63.4	26.8	50.3	59.7	25.3	47.4	58.6	24.8	16.16	35.6
64	94.2	276.7	92.1	1674	3.69	109	24.0	63.4	26.8	50.3	59.8	25.3	47.4	58.4	24.7	16.54	36.5
65	94.0	282.7	91.8	1676	3.69	109	24.0	63.5	26.9	50.4	59.9	25.3	47.5	58.3	24.7	16.92	37.3
66	93.8	288.7	91.5	1678	3.70	109	24.0	63.5	26.9	50.4	59.9	25.4	47.6	58.1	24.6	17.31	38.2
67	93.6	294.7	91.1	1680	3.70	109	24.0	63.6	26.9	50.5	60.0	25.4	47.6	57.9	24.5	17.69	39.0
68	93.4	300.6	90.8	1682	3.71	109	24.0	63.6	26.9	50.5	60.1	25.4	47.7	57.8	24.4	18.06	39.8
69	93.2	306.5	90.5	1684	3.71	109	24.0	63.6	26.9	50.5	60.1	25.5	47.7	57.6	24.4	18.44	40.6
70	93.0	312.4	90.0	1686	3.72	109	24.0	63.7	26.9	50.5	60.2	25.5	47.8	57.3	24.3	18.81	41.5
71	92.8	318.2	89.4	1688	3.72	109	24.0	63.7	27.0	50.5	60.3	25.5	47.8	57.0	24.1	19.18	42.3
72	92.6	324.0	88.9	1690	3.73	109	24.0	63.7	27.0	50.6	60.3	25.5	47.9	56.6	24.0	19.55	43.1
73	92.4	329.7	88.2	1692	3.73	109	24.0	63.7	27.0	50.6	60.4	25.6	47.9	56.2	23.8	19.91	43.9
74	92.2	335.3	87.5	1694	3.73	109	24.0	63.7	27.0	50.6	60.5	25.6	48.0	55.8	23.6	20.27	44.7
75	92.0	340.9	86.8	1696	3.74	109	24.0	63.8	27.0	50.6	60.5	25.6	48.0	55.4	23.4	20.63	45.5
76	91.8	346.5	86.2	1698	3.74	109	24.0	63.8	27.0	50.6	60.6	25.6	48.1	55.0	23.3	20.98	46.3
77	91.6	351.9	85.4	1700	3.75	109	24.0	63.8	27.0	50.6	60.6	25.7	48.1	54.5	23.1	21.33	47.0
78	91.4	357.3	84.6	1702	3.75	109	24.0	63.8	27.0	50.7	60.7	25.7	48.1	54.0	22.8	21.68	47.8
79	91.2	362.7	83.8	1704	3.76	109	24.0	63.8	27.0	50.7	60.7	25.7	48.2	53.5	22.6	22.02	48.5
80	91.0	368.0	83.0	1705	3.76	109	24.0	63.9	27.0	50.7	60.8	25.7	48.2	53.0	22.4	22.36	49.3
81	90.8	373.2	82.2	1706	3.76	109	24.0	63.9	27.0	50.7	60.8	25.7	48.2	52.5	22.2	22.69	50.0
82	90.6	378.4	81.3	1707	3.76	109	24.0	63.9	27.0	50.7	60.8	25.8	48.3	52.0	22.0	23.02	50.7
83	90.4	383.5	80.5	1708	3.77	109	24.0	63.9	27.1	50.7	60.9	25.8	48.3	51.5	21.8	23.34	51.5
84	90.2	388.5	79.7	1709	3.77	109	24.0	63.9	27.1	50.7	60.9	25.8	48.3	51.0	21.6	23.67	52.2
85	90.0	393.5	78.9	1710	3.77	109	24.0	64.0	27.1	50.8	61.0	25.8	48.4	50.5	21.4	23.98	52.9

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The data and recommendations presented in this publication are based upon extensive field observations and in-house test results. The performance goals and specification are presented only as a guide to flock management and do not constitute a warranty or guarantee that equal or similar performance will be achieved. The recommendations set forth in this publication in no way constitute a WARRANTY or GUARANTEE EXPRESSED or IMPLIED OF PERFORMANCE, HEALTH, MERCHANTABILITY or TOLERANCE TO A DISEASE.

NOTES

NOTES

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