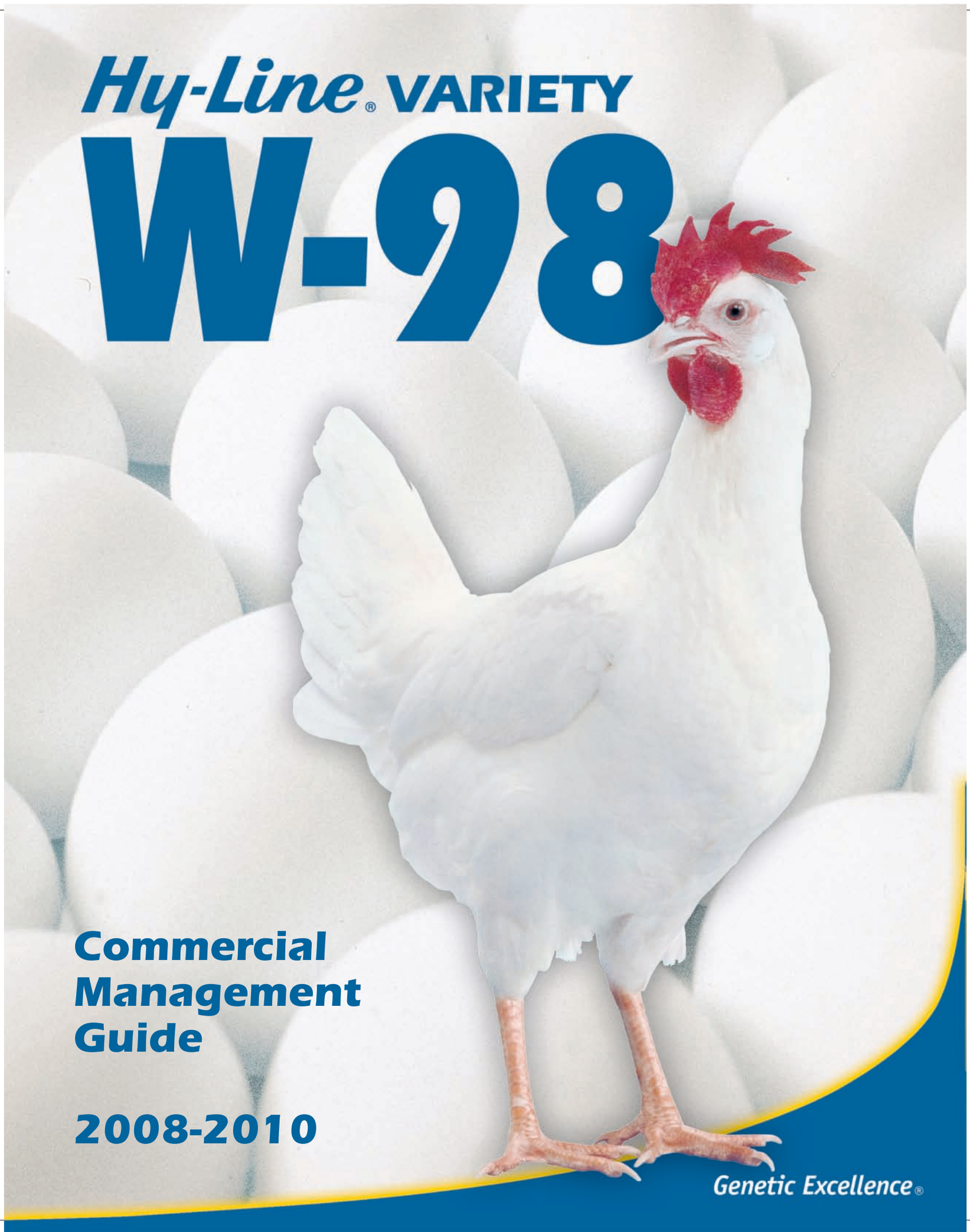
Hy-Line® VARIETY

W-98



Commercial Management Guide

2008-2010

Genetic Excellence®

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Hy-Line International is committed to providing proper care for its flocks. Hy-Line subscribes to the husbandry practices for egg laying chickens as outlined by the United Egg Producers (UEP). We believe that it is our obligation to provide good management and husbandry practices for poultry, including proper housing, feeding, watering, lighting, ventilation, sanitation and vaccination programs to protect the health and welfare of all our flocks.

Capabilities of the Hy-Line W-98

Growing Period (to 16 weeks):

Livability	98%
Feed Consumed	5.05 kg (11.1 lb)
Body Weight at 16 Weeks	1.23 kg (2.71 lb)

Laying Period (to 80 weeks):

Percent Peak	93–94%
Hen-Day Eggs to 60 Weeks	249–254
Hen-Day Eggs to 80 Weeks	351–359
Hen-Housed Eggs to 60 Weeks	246–250
Hen-Housed Eggs to 80 Weeks	342–350
Livability to 60 Weeks	97%
Livability to 80 Weeks	93%
Days to 50% Production (from hatch)	137 Days
Egg Weight at 32 Weeks	60.1 g/egg (47.7 lb/case)
Egg Weight at 70 Weeks	65.6 g/egg (52.1 lb/case)
Total Egg Mass per Hen-Day (17–80 weeks)	21.8 kg (48.1 lb)
Body Weight at 32 Weeks	1.61 kg (3.55 lb)
Body Weight at 70 Weeks	1.67 kg (3.68 lb)
Shell Strength	Excellent
Haugh Units at 32 Weeks	92
Haugh Units at 70 Weeks	81
Average Daily Feed Consumption (17–80 weeks)	98 g/bird/day (21.5 lb/100 birds/day)
lb Feed/lb Eggs or kg Feed/kg Eggs (20–60 weeks)	1.85
lb Feed/lb Eggs or kg Feed/kg Eggs (20–80 weeks)	1.93
Feed per Doz. Eggs (20–60 weeks)	1.35 kg (2.97 lb)
Feed per Doz. Eggs (20–80 weeks)	1.44 kg (3.18 lb)
Condition of Droppings	Dry

Figures contained in this management guide have been compiled from extensive commercial flock records gathered from all parts of the world to the date of printing of this guide. Further management suggestions listed in this booklet are combined principles taken from industry technical literature and field experience with this variety. Neither the performance figures nor management suggestions are in any way a guarantee of performance. Productivity of a commercial flock of any variety layer will vary according to environment and disease conditions.

Chick Management

Hy-Line W-98 chicks adapt equally well to floor and cage brooding systems. They require no special hatchery services except vaccination against Marek's disease.

General Recommendations

1. Prior to delivery of chicks:
   a. Clean and disinfect cages or floor brooding area and equipment, the building interior and attached service areas and equipment.
   b. Check to make sure equipment is working properly and is adjusted to the right height.
   c. Remove all old feed from bins, hoppers, and troughs. Disinfect and allow to dry before new feed is delivered.
   d. Place rodenticide where it will not be consumed by the chicks.
2. One day before delivery:
   a. Set heating system at 32–33°C (90–92°F) for cage brooding or at 32–35°C (90–95°F) at chick level for floor brooding.
   b. Check water system. Adjust to proper height for chicks. Disinfect and flush water lines.
3. On delivery day:
   a. Have waterers full or water system in operation. Check brooder temperatures.
   b. As chicks are placed, trigger water cups or nipples to encourage drinking.
   c. When nipple drinkers are used, reduce the water pressure so birds can see the drop of water hanging on the drinker.
   d. Feed should be placed on paper in cage. Operate feeders at highest feed level.
   e. Keep light at high intensity 20–22 hours per day for the first week.

Growing Period Management

The first 16 weeks of a pullet's life are critical. Astute management during this period can assure that she reaches the laying house ready to deliver her bred-in performance potential. Mistakes made during the first 16 weeks generally cannot be corrected in the laying house.

General Recommendations

1. Grow pullets in strict isolation from older birds. Maintain good sanitation. Plan work routines so that disease causing agents cannot be carried from older birds to the growing pullets.
2. During the first six weeks, operate feeders to provide feed at least twice daily, or more often. After six weeks, check feed consumption and body weights against the charts on page 11 and 12.
3. Weigh 100 pullets weekly during the growing period, beginning at five weeks of age.
4. Check water availability in each cage row daily. Check for and repair leaks. Raise waterers as the birds grow (nipples higher than the birds' heads; cups or troughs level with their backs).
5. Plan and follow a vaccination schedule to fit the area (see page 7). A Hy-Line representative can be of assistance in making recommendations.
6. Remove mortality daily and dispose of properly. Examine for causes of excessive mortality.
7. Three days before moving pullets to the laying house, begin using water-soluble vitamins and electrolytes in the drinking water. Continue for three days after housing. This helps minimize the stress of moving. Handle birds gently during transfer to avoid injuries.
8. Pullets should be housed at 16 weeks of age, before the onset of sexual maturity.

Growing Space Recommendations			
Cage		**Floor**	
Floor Space:	310 cm² (48 sq in)	**Floor Space:**	835 cm² (0.9 sq ft)
Feeder Access:	5 cm/bird (2 in/bird)	**Feeder Access:**	5 cm/bird (2 in/bird) 1 pan/50 birds
Water Access:		**Water Access:**	
Trough:	2.5 cm/bird (1 in/bird)	**Trough:**	2.0 cm/bird (0.8 in/bird)
Cups/Nipples:	1 per 8 birds	**Cups/Nipples:**	1 per 15 birds
Fountains:	—	**Fountains:**	1 per 150 birds

Cage Brooding

Before the birds arrive, prepare the house as follows:

1. Put nonskid paper on the bottom of the cage. This paper may disintegrate and fall through the cage bottom or it should be removed at beak trimming time (10 days).
2. Start the heating system 24 hours before the birds arrive. Adjust the temperature to 32–33°C (90–92°F).
3. Keep the relative humidity at 40–60%. In cage brooding, maintaining adequate humidity is very important. If necessary, sprinkle water on the walks or floors to increase humidity.

Temperature Management

Look for signs of overheating (panting and drowsiness) or chilling (huddling and loud chirping) and make appropriate adjustments. Heat control is more critical in cage brooding because the chicks cannot move to find their comfort zone.

Floor Brooding

Twenty-four hours before delivery of the chicks, prepare the house as follows:

1. Place a brooder ring around each brooder unit.
2. Adjust temperature to 32–35°C (90–95°F).
3. Fill jug waterers—two 4-liter (one gallon) waterers per 100 chicks.
4. Eliminate all drafts from the house.

Temperature Management

Observing the chicks will tell you whether or not the temperature is correct. If they are too cool, they will huddle near the heat source. If they are too warm, they will spread out away from the heat source. If there are drafts, they will huddle in groups to get away from the spot where the cool air enters the heated area. Comfortable chicks will spread out uniformly, without huddling, throughout the brooding area.

Maintain adequate relative humidity for birds brooded on the floor. The chicks seem to be comfortable and do better when relative humidity is between 40–60%.

Brooding Temperatures

Age	Cage Brooding		Floor Brooding	
	°C	°F	°C	°F
Day 1–3	32–33	90–92	33	92
Day 4–7	30–32	86–90	31	88
Day 8–14	28–30	82–86	29	84
Day 15–21	26–28	78–82	27	80
Day 22–28	23–26	74–78	24	76
Day 29–35	21–23	70–74	22	72
Day 36→	21	70	21	70

Beak Trimming

Beak trimming is not necessary in all management systems, however, if beak trimming is done, proper procedures should be followed.

The Hy-Line W-98 pullet is most successfully beak trimmed at hatch by infrared beak treatment or between 7–10 days of age using a precision cam activated beak trimmer with guide plate holes of 4.00, 4.37, and 4.75 mm (10/64, 11/64, and 12/64 in). The proper size hole should be selected to provide the width of 2 mm between the nostrils and the cauterizing ring. The proper size hole will depend both on size and age of the chicks. Under some management systems beaks should be re-trimmed at 12–14 weeks of age.

A cherry red color blade has been recommended for proper cautery. However, a better way to measure blade temperature is by use of a pyrometer to keep the blade at approximately 595°C (1100°F). The use of a line voltage meter and chart available from Lyon will facilitate maintaining the proper blade temperature at all times. A variation of 38°C (100°F) is common due to external influences and cannot be detected by the human eye.

The following precautions must be observed at all times:

1. Do not beak-trim sick birds
2. Do not hurry.
3. Use electrolytes and vitamins (containing vitamin K) in the water two days before and two days after beak trimming.
4. Keep feed at the highest level for several days after beak trimming. If a coccidiostat is being used in the feed, supplement it with water soluble coccidiostats until feed consumption returns to normal.
5. Use only well trained crews for beak trimming.

Floor Systems Management

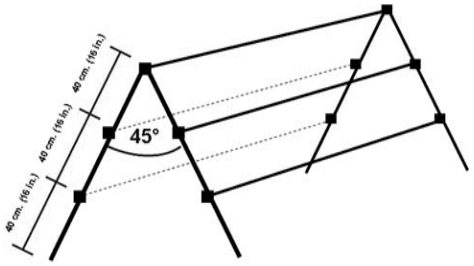
The Hy-Line variety W-98 is widely used successfully in floor systems due to her good livability and nest behavior. It is important to provide the birds with the best possible floor environment to achieve the performance potential of the Hy-Line variety W-98.

Growing Period

Lighting—Birds should be grown in housing that allows adjustment to the lighting program and the light intensity. The lighting programs are usually similar to those used for birds in cage production, but light intensity may be different. It is important to provide floor grown birds with enough light intensity to allow them to navigate their environment. Week-one light intensity of 20–30 lux (2–3 foot-candles) should be used, dropping down to 15 lux (1.5 foot-candles) by week four and remaining at the level until week 15. At week 15, gradually increase the light intensity, reaching 20–30 lux (2–3 foot-candles) by the time the pullets are transferred to the layer house. Birds moving into open-sided housing should have higher light intensities of 30–40 lux (3–4 foot-candles) at the time of housing.

Perches—Perches provide a significant improvement to the growing and laying house environment. In grow, they allow birds to fully develop their leg and flight muscles which are essential in the birds ability to navigate the lay house environment. Perches reduce the social stress of the floor by providing a roost for rest periods. The perches also reduce the social pressure in the environment as they use the total available space in the house efficiently increasing floor space. Piling is a common problem in flocks who do not have access to perches.

Perch Dimensions



Bird Density		Length Per Bird	
m²	ft²	cm	in
7	1.4	2	0.75
8	1.3	4	1.50
9	1.2	6	2.25
10	1.1	8	3.00
12	0.9	2	4.50

Place perches on slats where possible to maintain good litter conditions. Distance between perches on A-frame design should be 40 cm (16 in) and at a slope of 45°.

Body Weight—It is essential that birds have access to the same type of feeder and water system in the growing house that they will have in the laying house. Birds will adapt better in the lay house if the growing house has perches. If birds are being grown at 12 birds/m² (0.9 ft²/bird) then each bird will need 6 cm (2.2 in) of perch when using an A-frame construction. Use a spacing of 40 cm (16 in) between perches and angle of 45°. Ideally, the growing house should have elevated bird walkways with the feed and water stations up on them.

Birds grown on the floor will often be as much as 50 g (0.1 lb) lower in body weight at 12 weeks of age than cage-grown birds. To offset any decrease in egg size, it is common to delay light stimulation until the pullets reach 1.27 kg (2.8 lb).

Relative Humidity—Birds are very sensitive to extremes of relative humidity (RH). It is common to see young flocks in floor houses with RH dropping below 30%. This will cause increased agitation of the chicks and can cause aggressive behavior. Ideally, RH should be in the 40–60% range. Excessive moisture will cause poor litter conditions. Wet litter will be associated with high ammonia levels, poor air quality and promotes enteric diseases. This must be avoided to prevent respiratory problems.

Socialization—It is important to socialize the birds to humans by walking through the chicks daily. It is recommended the birds be walked at two hour intervals. This would give the birds time to relax and settle between walkings. Brighten the house and walk briskly through the house to improve the process of socialization.

Beak Trimming—The Hy-Line W-98 pullet is usually beak trimmed either in the hatchery by infrared beak treatment or at 7–10 days of age.

Laying Period

Lighting—Ensure that the feed and water systems in the growing and laying facilities are compatible. Check the lighting program and light intensity. Synchronize light times with the growing house. The W-98 layer will need bright light of at least 20 lux (2 foot-candles). It is important not to have shadows in the lay house, as dark areas outside the nest will encourage floor eggs. Allow the pullets access to the nests during the day when they arrive. Place the pullets on the slats at housing. Walk the birds several times daily, particularly in the morning, to ensure the birds are finding feed and water.

Training Period—Training the birds to use the nest will require frequent walks through the birds in the mornings for the first eight weeks after the birds are placed in the laying house. Use of electric fence on the slats around the house perimeter is helpful in discouraging egg laying in corners or near the walls. The fence must be turned on as soon as the birds are housed. Place the electric slat wires 5 cm (2 in) away from the wall or the house and about 10 cm (4 in) above the floor. An electric fence over water and feed lines can be counter productive as they increase nervousness among the birds and should be avoided. Use of solid perches above water and feed lines are preferred.

Nests—Consider opening nest box curtains to encourage nest exploration in young laying flocks. This will help prevent smothering inside the nests. Create false walls that are 1 m (3 ft) in length every 12 m (39 ft) along the line of nest boxes.

House Layout—The litter area in layer houses should not be more than 60 cm (24 in) below the slat area. Position lights to eliminate shadows on the litter below the slat area. Position lights to provide the brightest light intensity over the litter or resting areas and the lowest light intensity at the front of the nest boxes. Flocks housed in all-slat houses should also be grown on slat or wire floors.

Recommended Cage Free Densities for the Hy-Line W-98 Layer (Adult)

Floor Space:	all litter	10 birds/m² (1.1 sq ft/bird)
	all slat	12 birds/m² (0.9 sq ft/bird)
	combination of litter/slat	11 birds/m² (1.0 sq ft/bird)
Feeder Access:	straight trough	8 cm (3 in)
	round pans	40 birds
Water Access:	1 nipple/cup	per 10 birds
	2.5 cm (1 in) water trough	per bird
	1–46 cm (18 in) diameter circular automatic water fountain	per 125 birds
Nest Space:	colony nest, single tier, 1.1–1.4 m (3.5–4.5 ft) width	160 birds/nest (80 birds/side)
	individual nest	8 birds/nest

Disease Control

A flock of pullets or layers can only perform up to its genetic potential when disease influence is minimized. The appearance of various diseases can vary from a subclinical effect on performance to outright severe mortality. The diseases of economic importance vary widely between locations, but in every case the challenge is to identify and control those diseases.

Biosecurity

Biosecurity is the best method of avoiding disease. A good biosecurity program identifies and controls the most likely ways a disease could enter the farm. Human and equipment movement onto the farm should be strictly controlled. Visitors to the farm should be limited to those who are essential for its operation. All visitors and workers should enter at a central location. Visitors should use a logbook to document their visits. Anyone having been on another poultry facility within 48 hours should not be permitted access. Clean boots, clothing and head cover should be provided for everyone working or visiting the farm. Clean footbaths containing disinfectant should be placed outside the entries to all poultry houses. If possible, avoid using outside crews or equipment for vaccination, moving, and beak trimming. Ideally, workers should be limited to a single house. The number of flocks visited in one day should be limited, and always progressing from younger to older flocks, and from healthy to sick flocks. After visiting a sick flock, no other flocks should be visited.

The removal of old hens from the farm is a time when disease can be introduced. The trucks and crews used to transport old hens have often been on other farms. A plan should be developed to minimize the biosecurity risk during times outside crews or equipment are needed for vaccination, moving pullets, and beak trimming.

A single-aged growing farm using the all-in/all-out principle is best. This will prevent the transmission of disease from older flocks to younger, susceptible flocks. Al houses should be designed to prevent exposure of the flock to wild birds. Quickly and properly dispose of dead chickens.

Rodents are known carriers of many poultry diseases and they are the most common reason for re-contamination of a cleaned and disinfected poultry facility. They are also responsible for house-to-house spread of disease on a farm. The farm should be free of debris and tall grass that might provide cover for rodents. The perimeter of the house should have a 1 m (3 ft) area of crushed rock or concrete to prevent rodents from burrowing into the houses. Feed and eggs should be stored in rodent-proof areas. Bait stations should be placed throughout the house and maintained with fresh rodenticide.

Cleaning and disinfection of the house between flocks serves to reduce the infection pressure for a new incoming flock. The house should be cleaned of organic matter by high pressure spraying with a warm water containing a detergent/disinfectant. Allow time for the detergent to soak. After drying, the house should be disinfected or fumigated and allowed to dry again before repopulating with birds. Heating the house during washing improves the removal of organic matter. Wash the upper portion of the house before the pit. Thoroughly clean the air inlets, fan housing, fan blades and fan louvers. Flush and sanitize the water lines. All feed and manure should be removed from the housing before cleaning. Allow a minimum of two weeks downtime between flocks.

Monitoring of poultry houses for the presence of pathogenic species of *Salmonella*, particularly *Salmonella enteritidis*, is recommended. This can be done by routine testing of the environment using drag swabs.

Vertically Transmitted Diseases

Some diseases are known to be transmitted from infected breeders to their progeny. This requires the production and maintenance of disease-free breeders as a first step in the control of these diseases at the commercial level. All breeders directly under Hy-Line's control are free of *Mycoplasma gallisepticum*, *Mycoplasma synoviae*, *Salmonella pullorum*, *Salmonella gallinarum* (typhoid), *Salmonella enteritidis*, and lymphoid leukosis. Due to the possibility of horizontal transmission of any of these diseases, later generations may not remain free. It is the responsibility of the breeding and commercial flock owner to prevent horizontal transmission of these diseases and to continue testing to be assured of a negative status.

Vaccination

Certain diseases are too widespread or difficult to eradicate and require a routine vaccination program. In general, all layer flocks should be vaccinated against Newcastle, bronchitis, Infectious Bursal Disease (IBD) and Avian Encephalomyelitis (AE). The exact vaccination schedule depends upon many things such as diseases exposures expected, maternal immunities, vaccine types available and routes of administration preferred. Therefore, no one program can be recommended for all locations. Consult with local veterinarians to determine the best vaccination program for your area. Following is a basic program where breeders receive an inactivated Newcastle-bronchitis-IBD vaccine.

Hatchery	Marek's Disease, HVT/SB-1 or HVT/Rispens
18–20 days	IBD intermediate strain in water
24–26 days	IBD intermediate strain in water, Newcastle B-1 and bronchitis, mild Mass., in water
30–32 days	IBD intermediate strain in water
7–8 weeks	Newcastle B-1 and bronchitis, regular Mass. in water or spray
10 weeks	Pox wingweb and AE wingweb, water or spray
14 weeks	Newcastle LaSota and bronchitis, mild Holland spray or Newcastle-bronchitis killed virus injection

Infectious Bursal Disease

Special attention should be paid to IBD control. This disease can have many subtle effects which are detrimental to pullet health. The primary feature of IBD is immuno-supression caused by damage to the bursa of Fabricius which leaves the bird unable to fend off other disease challenges. Secondary diseases such as gangrenous dermatitis, bacterial arthritis, peritonitis, and even Marek's often result. Virtually all flocks are exposed to IBD and therefore, should be protected by vaccination. Most breeding stock receives a killed IBD vaccine to boost maternal titers in the chicks. Research at Hy-Line International has shown the optimum time to vaccinate such chicks with intermediate strain live vaccines is at 18–20 days, 24–26 days and at 30–32 days of age. Extremely severe IBD challenge may require even more frequent vaccination during this period. Bursas can be examined later to determine the extent of protection.

Internal Parasites

Internal Parasites

Infections with internal parasites cause damage to the bird's gut. This may result in a variety of problems including:

- Loss of shell strength, yolk color, and egg size.
- Poor body weight gain leading to unevenness or stunted birds. Affected birds may be dull and show pale combs.
- Increased cannibalism through vent pecking due to straining.
- Death, in very heavy infestations.

There are three main worms that may cause problems in free-range or cage birds:

1. **Roundworms (*Ascaridia galli*)**
   These are the largest and most common. They are white, up to 5 cm (2 in) long and may be visible in droppings in heavy infestations.
2. **Hairworms (*Capillaria*)**
   These are much smaller (hair-like) and are barely visible with the naked eye but can cause significant damage even in only moderate infestations.
3. **Cecal worms (*Heterakis gallinarum*)**
   As their name suggests, these worms spend most of their time in the lower end of the gut, the ceca. They cause no obvious harm in themselves, but can carry another parasite, Histomonas, into the birds. Histomonas is the cause of blackhead and hence control of one parasite can help to control another.

Birds become infected by picking up worm eggs from litter, soil, or feces. The worm eggs need warm moist conditions to develop outside the bird, which is why problems are frequently worse in the spring and summer, especially following a wet spring. Worm burdens can be identified by examination of feces, culled birds, or worm egg counts on bulk feces.

A product used for roundworm treatment in the United States is Piperazine at 50 mg/bird (0.1%) for 24 hours. A possible licensed dewormer in some countries for laying birds is Flubenvet. (Janssen Animal Health) This product has no withdrawal period, which means that it can be given in the feed during lay without the need to discard eggs, except in organic diets where eggs may need to be withheld.

Effective control is aimed at breaking the cycle of infection. Strategic use of anti-parasitic drugs (in the rearing phase) will help to reduce challenge, but this needs to be combined with limiting stock density on land, the use of range rotation, good drainage, and the removal of heavily contaminated soil around the house before new pullets arrive.

Coccidiosis

This parasitic infection of the intestines can lead to gut damage and, in severe infestations, death of birds. More commonly, poor control of sub-clinical infection, reduced feed conversion, or leaves pullets with chronic irreversible gut damage. Such flocks may be uneven or underweight at housing, and may not perform to their full potential in lay. Currently, effective control is achieved with drug treatments in feed that suppress oocyst output. These may involve the use of ionophores or chemicals on a step-down program to ensure immunity in pullets. An alternative to anti-coccidial drug treatments is using a live vaccine. Live coccidial vaccines are available that can be administered by spray in the hatchery or by feed or water application the first few days in the brooder house. All treatment/vaccination strategies should be supported with effective biosecurity. The use of a disinfectant with proven efficacy against coccidial oocysts will reduce challenge pressure. Maintenance of good dry litter will reduce oocyst build up.

External Parasites

Red Mite or Northern Fowl Mite

Mites are a cause of increasing problems in free-range and caged layers. It is particularly severe in the summer months when the weather is warm and mites are able to multiply quickly.

Even light infestations can irritate the birds, leading to poor performance and reduced feed intake. In more severe cases, infestations can lead to some or all of the following:

- Mites irritate the birds and can make the flock unsettled and nervous.
- The incidence of peritonitis may increase and there may be increased vent pecking.
- Feed intake may be depressed.
- Heavy mite infestations can depress egg production up to 5%.
- Heavy infestations of red mites will make birds anemic due to loss of blood. Birds will be evident in the flock with pale combs and, if severely affected, mortality may increase.
- There may be loss of yolk color and, with heavy infestations of red mites, there will be evidence of mites and mite feces on eggs and egg belts, which may lead to downgrading of speckled eggs.
- There may be an increase in floor eggs as birds will be reluctant to use heavily infested nests.
- Where there are heavy mite infestations, egg collectors may experience skin irritation.

Control strategies involve two broad areas:

1. Breaking the cycle of re-infection when the house is empty is the most effective approach. Treat the houses effectively at site depletion with an approved product, properly applied, to reach into all crevices on equipment, slats, and nest boxes. Use a fan nozzle to produce a flat spray. Do not mix pesticides with disinfectants.

2. Monitor the house and birds during the life of the flock to allow prompt treatment even if only light infestations are identified. Programs for treatment to break the Northern Fowl Mite life cycle (5–7 days) should be done three times on day 0, 5, and 10. Treatment to break the Red Mite life cycle (10 days) should be done three times on day 0, 10, and 20.

Lighting Program

Egg Production is very closely related to the changes in day length to which the pullets are exposed. Egg numbers, egg size, livability and total profitability can be favorably influenced by a proper lighting program.

1. Start pullets with 20–22 hours of light the first week at 30 lux (3 foot-candles) intensity. Reduce light to 20 hours the second week at 5 lux (1/2 foot-candles). The following weeks, reduce light duration to reach 8–9 hours day length by 7–9 weeks of age or in open houses, the longest natural day length between 6 and 17 weeks of age. (see example page 8)
2. Provide the light stimulation when body weight is 1.27 kg (2.8 lb). The initial increase should be one hour or less. Increase light by 15–30 minutes per week or biweekly until 16 hours of light is reached. Preferably the period of stimulation should last until 28–32 weeks of age. Light intensity should also be increased at housing to 10–30 lux (1–3 foot-candles).
3. Allow no decrease in day length or light intensity in adult layers.

Local sunrise-sunset timetables should be obtained to accurately design individual programs. Guidelines are as follows:

1. Light-controlled growing to light-controlled laying:
   a. Step-down day length from 20–22 hours the first week to 8–9 hours by 7–9 weeks of age. Then maintain a constant day length to 17 weeks.
   b. Increase day length 1 hour at 1.27 kg (2.8 lb). Add 15–30 minutes per week until 16 hours total light is reached.
2. Light-controlled growing to open or brownout laying:
   a. Step-down day length from 20–22 hours the first week to 8–9 hours by 7–9 weeks of age, or one hour less than natural day length at 17 weeks of age.
   b. Increase to natural day length or a minimum increase of 1 hour at 1.27 kg (2.8 lb). Add 15–30 minutes per week or every 2 weeks until 16 hours total light, or at least the longest natural day length of the year.
3. Open or brownout growing to light-controlled laying:
   a. Step-down day length from 20–22 hours the first week to 8–9 hours by 7–9 weeks of age or, if longer, the longest natural day length between 6 and 17 weeks of age.
   b. Increase day length one hour at 1.27 kg (2.8 lb). Add 15–30 minutes per week or every two weeks until 16 hours of total light is reached.
4. Open or brownout growing to open or brownout laying:
   a. Step-down day length from 20–22 hours the first week to 8–9 hours by 7–9 weeks of age or the longest natural day length between 6 and 17 weeks of age.
   b. Increase one hour at 1.27 kg (2.8 lb). Add 15–30 minutes per week or every 2 weeks until 16 hours of total light is reached, or at least the longest natural day length of the year.

Timing of Light Stimulation

Onset of sexual maturity or egg production generally depends on four requirements:

1. A minimum chronological age which is genetically determined (17 weeks).
2. A minimum body weight (1.27 kg or 2.8 lb).
3. A nutrient intake to support production.
4. A constant or increasing day length of at least 12 hours.

Light stimulation should not be provided until flocks reach the optimum body weight of 1.27 kg (2.8 lb). Flocks which are light-stimulated into production at lower body weights will likely produce below normal egg size and suffer from reduced peak production and post-peak drops in production.

Timing of light stimulation can be used as a tool to help attain desired egg size. In general, earlier light stimulation will result in a few more eggs per hen, but at a tradeoff for slightly reduced egg size. Later light stimulation will result in a few less total eggs, but a slightly larger egg size earlier in production. In this way, lighting programs can be customized to best meet the egg size demand of a particular market.

Midnight Feeding

An optional lighting technique that will promote more feed consumption is the “midnight feeding.” The technique involves turning the lights on for 1 hour in the middle of the dark period and running the feeders during this time. For a typical layer lighting program with 16 hours of light and 8 hours dark, the night would consist of 3.5 hours of darkness, one hour of light, and 3.5 hours of darkness. The regular 16 hour light period should not be changed. The hour of light can be added all at once, but if it is removed at a later time, that should be done gradually, at the rate of 15 minutes per week. Midnight feeding will generally increase feed intake about 2–5 g/bird/day (0.4–1.0 lb/100 birds/day). The technique is applicable for heat stress conditions, or any time more feed intake is desired in either growing or laying flocks.

Planning Individual Light Programs

When open-type houses are used, which allow natural daylight to affect the flock, the lighting program must be planned in conjunction with changes in the natural day length. Because no two places have the same sunrise-sunset times year-round, it is impractical to suggest time clock settings that would apply to all locations. For the most precise planning, it is necessary to obtain local sunrise-sunset times for the entire year and construct a graph as the example on the following page demonstrates.

In this example, the growing flock is maturing in the spring when there is a naturally increasing day length. To prevent early sexual development, find the natural day length at 17 weeks of age and hold that day length constant with artificial lights from 8 to 17 weeks.

Custom lighting programs for any location worldwide are available on the Hy-Line website. (www.hyline.com)

Egg Size Management

Egg size is to a large extent genetically determined, but within this given range, we can manage to either increase or decrease the egg size to suit the particular market needs.

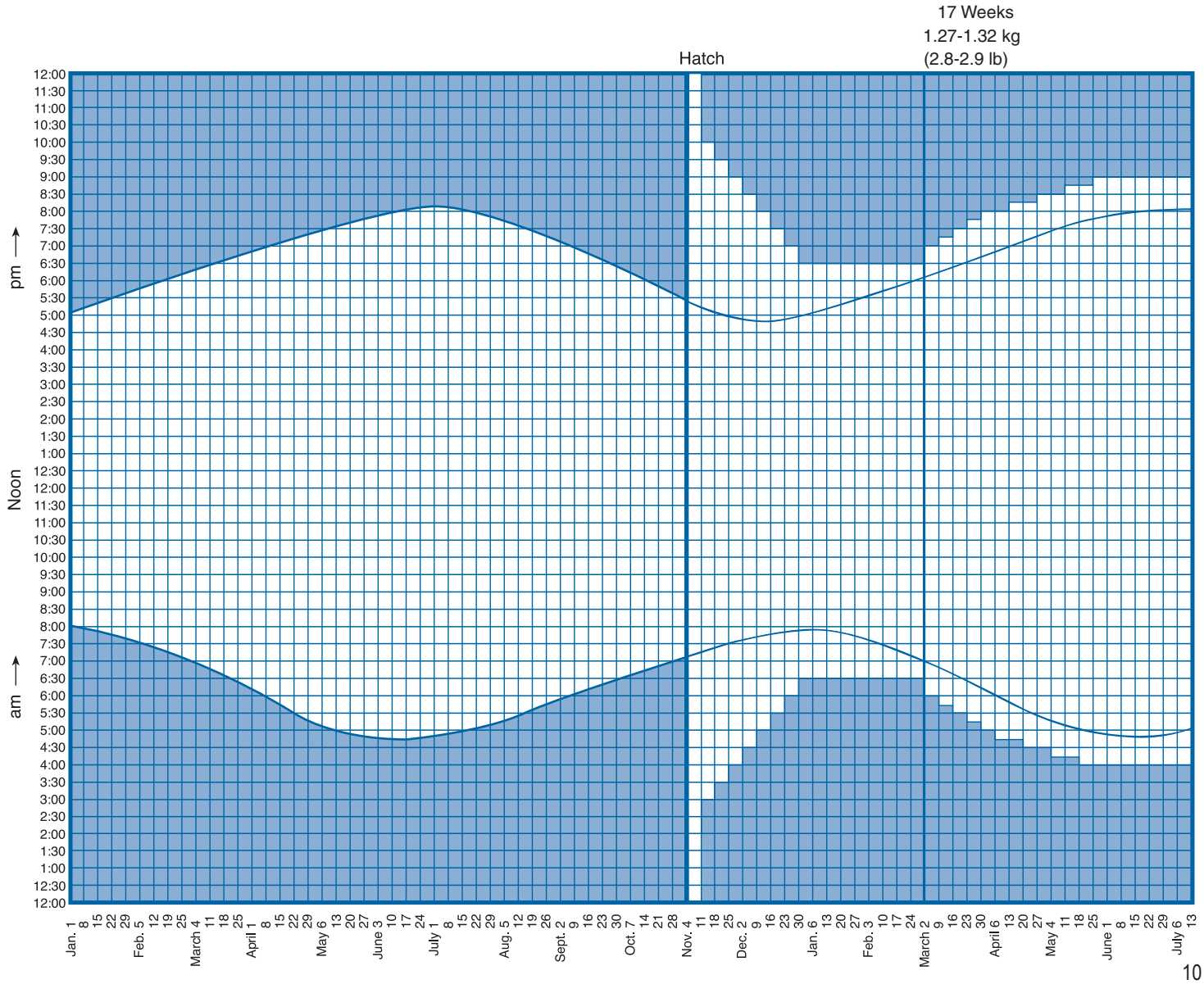
The following management areas should be given particular attention.

1. **Body weight at maturity**—The larger the body weight at first egg, the larger that hen's eggs will be for her entire life. For maximum egg size, do not stimulate maturity with lights until a body weight of 1.27 kg (2.8 lb) is attained.

2. **Rate of maturity**—This also relates to body size, but in general the earlier the age a flock begins production, the smaller the egg size will be, and likewise, the later the maturity, the larger the egg size. Lighting programs can be manipulated to influence rate of maturity. A decreasing light pattern after 12 weeks of age during growing will delay maturity and increase average egg size.

3. **Nutrition**—Egg size is greatly affected by the intake of crude protein, specific amino acids such as methionine and cystine, energy, total fat, and the essential fatty acids such as linoleic acid. Levels of these nutrients can be increase to improve early egg size and gradually reduced to control late egg size. (See layer feeding program page 13.)

Sunrise and Sunset
42° Latitude Northern Hemisphere



Growing Period Nutritional Recommendations

Phase Age in Weeks W-98 Body Weight			Starter 0–6 to 450 g (0.99 lb)	Grower 7–12 to 1000 g (2.20 lb)	Developer 13–15 to 1180 g (2.60 lb)	Pre-Layer 16–5% Production
Nutrients:						
Protein	%	Min.	20.0	18.0	16.0	15.5
Metabolizable Energy[1]	MJ/kg kcal/lb kcal/kg		12.2–12.6 1325–1375 2915–3025	12.2–12.6 1325–1375 2915–3025	12.0–12.6 1300–1375 2860–3025	11.8–12.1 1285–1315 2827–2893
Linoleic Acid	%	Min.	1.0	1.0	1.0	1.0
Amino Acids:						
Arginine	%	Min.	1.20	0.98	0.82	0.82
Lysine	%	Min.	1.10	0.90	0.75	0.75
Methionine	%	Min.	0.48	0.44	0.39	0.36
Methionine + Cystine	%	Min.	0.80	0.73	0.65	0.60
Threonine	%	Min.	0.70	0.60	0.50	0.50
Tryptophan	%	Min.	0.20	0.18	0.16	0.15
Minerals:						
Calcium	%	Min.	1.00[2]	1.00[2]	1.00[2]	3.00[3]
Av. Phosphorus	%	Min.	0.50	0.48	0.46	0.50
Sodium	%	Min.	0.19	0.18	0.18	0.18
Chloride	%	Min.	0.17	0.17	0.17	0.17
Potassium	%	Min.	0.50	0.50	0.50	0.50

(1) When the level of energy in the ration is increased or decreased (± 25–50 kcal) from stated levels, nutrient levels should be adjusted accordingly.
(2) Calcium during starter, grower and developer phases should be finely ground.
(3) Calcium level should be raised to a minimum of 3% for pre-layer feed beginning at 16 weeks, or when the flock shows signs of sexual maturity (blooming of combs). Do not use past 5% production. At least 30% of the added limestone should have a minimum particlal size of 2–4 mm.

Growing Period Feed Consumption[1]

age in weeks	daily			cumulative		
	g/bird/day	lb/100 birds/day	kcal/bird/day	g to date	lb to date	kcal to date
1	14	3.09	42	98	0.22	291
2	17	3.75	50	217	0.48	644
3	21	4.63	62	364	0.80	1081
4	29	6.39	86	567	1.25	1684
5	39	8.60	116	840	1.85	2495
6	43	9.48	128	1141	2.52	3389
7	46	10.14	137	1463	3.23	4345
8	49	10.80	146	1806	3.98	5364
9	52	11.46	154	2170	4.78	6445
10	54	11.91	160	2548	5.62	7568
11	55	12.13	163	2933	6.47	8711
12	57	12.57	169	3332	7.35	9896
13	59	13.01	174	3745	8.26	11111
14	60	13.23	177	4165	9.18	12347
15	62	13.67	182	4599	10.14	13624
16	64	14.11	183	5047	11.13	14905

(1) Feed consumption varies with feed formulation and environmental temperatures.

Monitoring Body Weights

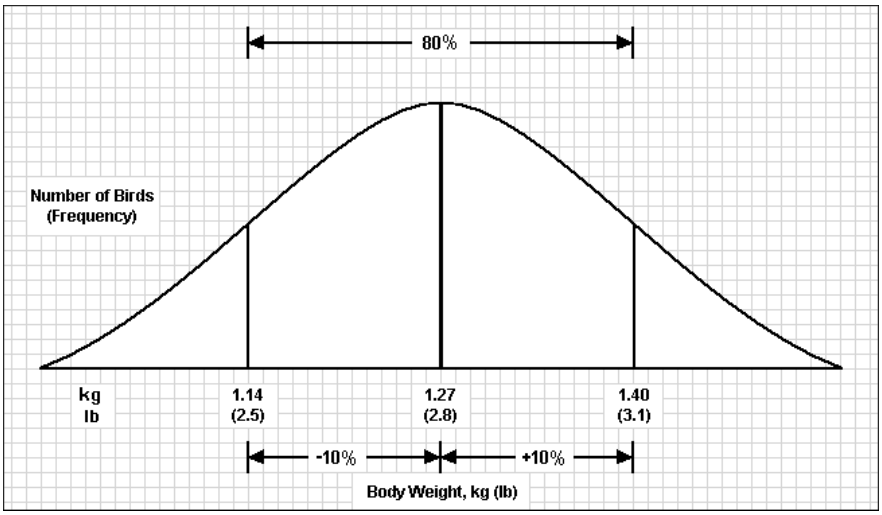
Body weights should be monitored periodically during the growing period and until after peak. At least 100 birds should be weighed individually with a scale having increments no larger than 50 g or 1/10 lb. Weighing should be started at five weeks of age and continued every two weeks during the growing period and until after peak. It is most critical to weigh just prior to a scheduled feed change. If the flock is below target body weight, it should be left on the higher nutrient feed formulation until the target weight for age is reached.

It is best to produce a large-framed pullet, but one that is not overweight or excessively fat. Encourage early feed consumption to stimulate growth and frame development, but avoid excessive weight gain in the period of 12–18 weeks of age.

Factors which can adversely affect body weight and uniformity are crowding, disease, poor beak trimming and inadequate nutrient and energy intake. Weighing at frequent intervals will determine the age at which a flock deviates from normal and thereby helps identify the problem so that corrective measures can be taken.

Variability Between Individual Birds Within A Flock

Uniformity of individual birds is important as well as appropriate average body weights. A general guideline is that 80% of birds will fall within 10% of the mean. Uniformity is expressed as the percent of individual weights which occur within 10% of the **current flock average**. This is, if the average flock weight at 17 weeks is 1.27 kg (2.8 lb), 80% of all birds should weigh between 1.14 kg (2.5 lb) and 1.40 kg (3.1 lb). Graph individual weights to be sure there is a bell shaped or "normal" distribution as shown below. To evaluate uniformity, at least 100 individual birds should be weighed. Typically, uniformity reaches 90% at point of lay, with lower values in younger and older birds.



Target Weights of Hy-Line W-98 Pullets
—Rearing Period—

	Age Weeks	Body Weight g	Body Weight lb
	1	65	0.14
	2	110	0.24
	3	180	0.40
	4	260	0.57
	5	350	0.77
	6	450	0.99
	7	550	1.21
	8	650	1.43
	9	750	1.65
	10	850	1.87
	11	930	2.05
	12	1000	2.20
	13	1070	2.36
	14	1130	2.49
	15	1180	2.60
Move to Lay House	16	1230	2.71
	17	1270	2.80

Laying Period Nutritional Recommendations

Minimum Daily Intake Recommendations per Bird - First Lay Cycle[1]

		5% to 32 Wks.	33–44 Wks.	45–58 Wks.	>58 Wks.
Protein[2]	g/bird	16.5	16.0	15.5	15.0
Methionine	mg/bird	400	376	352	327
Methionine Dig	mg/bird	372	350	327	304
Methionine + Cystine	mg/bird	660	620	580	540
Methionine + Cystine Dig	mg/bird	587	552	516	481
Arginine	mg/bird	945	900	860	820
Arginine Dig	mg/bird	869	828	791	754
Lysine	mg/bird	900	860	820	780
Lysine Dig	mg/bird	792	757	722	686
Threonine	mg/bird	600	575	550	520
Threonine Dig	mg/bird	504	483	462	437
Tryptophan	mg/bird	175	170	165	160
Tryptophan Dig	mg/bird	153	149	144	140
Calcium	g/bird	4.10	4.25	4.40	4.55
Phosphorus (Avail.)	g/bird	0.50	0.47	0.43	0.37
Sodium	mg/bird	180	180	180	180
Chloride	mg/bird	160	160	160	160

Formula Nutrient Profiles to Provide Minimum Daily Nutrient Recommendations for First Lay Cycle

5% to 32 Weeks[1]

Recommended Feed Energy 1275–1325 kcal/b or 2805–2915 kcal/kg or 11.7–12.2 MJ/kg[5]

Consumption Bird/Day g	Consumption Bird/Day lb	% Protein	% Methionine	% Met. Dig	% Methionine + Cystine	% Methionine + Cys. Dig	% Arginine	% Arg. Dig	% Lysine	% Lys. Dig	% Threonine	% Thr. Dig	% Tryptophan	% Trp. Dig	% Calcium[3]	% Avail. Phos.	% Sodium	% Chloride
≤ 86	≤ 19	19.20	0.47	0.43	0.77	0.68	1.10	1.01	1.05	0.90	0.70	0.58	0.21	0.17	4.75	0.58	0.21	0.19
91	0.20	18.15	0.44	0.41	0.73	0.65	1.04	0.96	0.99	0.87	0.66	0.55	0.20	0.17	4.51	0.55	0.20	0.18
95	0.21	17.35	0.42	0.39	0.70	0.62	0.99	0.92	0.95	0.83	0.64	0.53	0.19	0.16	4.30	0.52	0.19	0.17
100	0.22	16.50	0.40	0.37	0.66	0.59	0.95	0.87	0.90	0.79	0.60	0.50	0.18	0.15	4.10	0.50	0.18	0.16
104	0.23	15.78	0.38	0.35	0.63	0.56	0.91	0.87	0.86	0.76	0.58	0.48	0.17	0.14	3.92	0.48	0.17	0.15

33–44 Weeks[1]

Recommended Feed Energy 1250–1300 kcal/lb or 2750–2860 kcal/kg or 11.5–12.0 MJ/kg[5]

Consumption Bird/Day g	Consumption Bird/Day lb	% Protein	% Methionine	% Met. Dig	% Methionine + Cystine	% Methionine + Cys. Dig	% Arginine	% Arg. Dig	% Lysine	% Lys. Dig	% Threonine	% Thr. Dig	% Tryptophan	% Trp. Dig	% Calcium[4]	% Avail. Phos.	% Sodium	% Chloride
91	0.20	17.60	0.41	0.39	0.68	0.61	0.99	0.91	0.95	0.84	0.64	0.53	0.19	0.17	4.68	0.52	0.20	0.18
95	0.21	16.76	0.40	0.37	0.65	0.58	0.95	0.87	0.90	0.80	0.60	0.50	0.18	0.16	4.45	0.50	0.19	0.17
100	0.22	16.00	0.38	0.35	0.62	0.55	0.90	0.83	0.86	0.76	0.58	0.48	0.17	0.15	4.25	0.47	0.18	0.16
104	0.23	15.30	0.36	0.33	0.60	0.52	0.86	0.79	0.82	0.72	0.55	0.46	0.16	0.14	4.07	0.45	0.17	0.15
109	0.24	14.67	0.34	0.31	0.57	0.49	0.83	0.75	0.79	0.68	0.53	0.44	0.16	0.13	3.90	0.43	0.16	0.14

Laying Period Nutritional Recommendations

45–58 Weeks[1]
Recommended Feed Energy 1225–1300 kcal/lb or 2695–2860 kcal/kg or 11.3–12.0 MJ/kg[5]

Consumption Bird/Day		%	%	%	% Methionine +	% Methionine +	%	%	%	%	%	%	%	%	%	% Avail.	%	%
g	lb	Protein	Methionine	Met. Dig	Cystine	Cys. Dig	Arginine	Arg. Dig	Lysine	Lys. Dig	Threonine	Thr. Dig	Tryptophan	Trp. Dig	Calcium[4]	Phos.	Sodium	Chloride
95	0.21	16.30	0.37	0.35	0.61	0.54	0.91	0.83	0.86	0.75	0.58	0.48	0.17	0.15	4.61	0.45	0.19	0.17
100	0.22	15.50	0.35	0.33	0.58	0.52	0.86	0.79	0.82	0.72	0.55	0.46	0.16	0.14	4.40	0.43	0.18	0.16
104	0.23	14.90	0.34	0.32	0.56	0.50	0.83	0.76	0.79	0.69	0.53	0.44	0.15	0.14	4.21	0.41	0.17	0.15
109	0.24	14.20	0.32	0.30	0.53	0.48	0.79	0.72	0.75	0.66	0.50	0.42	0.15	0.13	4.03	0.39	0.16	0.14

>58 Weeks[1]
Recommended Feed Energy 1225–1300 kcal/lb or 2695–2860 kcal/kg or 11.3–12.0 MJ/kg[5]

Consumption Bird/Day		%	%	%	% Methionine +	% Methionine +	%	%	%	%	%	%	%	%	%	% Avail.	%	%
g	lb	Protein	Methionine	Met. Dig	Cystine	Cys. Dig	Arginine	Arg. Dig	Lysine	Lys. Dig	Threonine	Thr. Dig	Tryptophan	Trp. Dig	Calcium[4]	Phos.	Sodium	Chloride
95	0.21	15.80	0.35	0.32	0.57	0.50	0.86	0.79	0.82	0.72	0.55	0.47	0.17	0.15	4.77	0.39	0.19	0.17
100	0.22	15.00	0.33	0.30	0.54	0.48	0.82	0.75	0.78	0.69	0.52	0.44	0.16	0.14	4.55	0.37	0.18	0.16
104	0.23	14.40	0.32	0.29	0.52	0.46	0.79	0.72	0.75	0.66	0.50	0.42	0.15	0.13	4.35	0.35	0.17	0.15
109	0.24	13.75	0.30	0.28	0.50	0.44	0.76	0.69	0.72	0.63	0.48	0.40	0.15	0.13	4.17	0.34	0.16	0.14

(1) Layer diets should by formulated to provide suggested minimum nutrient intake on a per bird basis independent of feed intake.
(2) Protein (g/b/d) may be increased in conjunction with methionine + cystine and energy to increase egg size.
(3) A minimum of 50% added limestone should have particle size of 2–4 mm.
(4) Approximately 65% of the added limestone should have particle size of 2–4 mm.
(5) The lower dietary feed energy recommendations generally are for higher feed intake values.

Added Vitamins and Minerals

Added Minerals per Ton Finished Feed (minimum):		Grower 1,000 kg	Grower 2,000 lb	Layer 1,000 kg	Layer 2,000 lb
Manganese	g	66	60	66	60
Zinc	g	60	55	60	55
Iron	g	50	45	50	45
Copper	g	22	20	11	10
Iodine	g	1.7	1.5	1.1	1.0
Selenium	g	0.30	0.27	0.30	0.27
Added Vitamins per Ton Finished Feed (minimum):		**Grower**		**Layer Period[1]**	
Vitamin A	IU	11,000,000	10,000,000	8,800,000	8,000,000
Vitamin D_3-one half spray dried	IU	3,300,000	3,000,000	3,300,000	3,000,000
Vitamin E	IU	16,500	15,000	16,500	15,000
Vitamin K_3	mg	1,100	1,000	550	500
Thiamine B_1	mg	1,650	1,500	1,650	1,500
Riboflavin B_2-spray dried	mg	6,600	6,000	5,500	5,000
Pyridoxine B_6	mg	2,200	2,000	1,100	1,000
Vitamin B_{12}-all veg diet	mg	19.8	18.0	16.5	15.5
Pantothenic Acid	mg	11,000	10,000	6,600	6,000
Folic Acid	mg	385	350	220	200
Biotin	mg	55	50	(2)	(2)
Niacin	mg	33,000	30,000	22	20
Choline	g	330(3)	300(3)	275	250

(1) Based on daily feed intake of 100 g/bird/day (22 lb per 100 birds per day).
(2) No added Biotin needed in corn based diets, otherwise supplement same as growing diets.
(3) May be reduced by 50% after 8 weeks.

Laying Period Feed Consumption and Energy Intake

The amount of feed a flock consumes is dependent on several factors, i.e., feed nutrient content (particularly caloric content), house temperature, rate of production, egg size and body weight.

The following table suggests expected feed consumption for the W-98 layer under thermoneutral conditions using a modern-type layer diet. The daily energy values are based on the energy prediction equation on page 16 (with modification based on actual performance experience for the W-98 layer) assuming standard body weight, production and egg size values from the performance table (pages 21–22) and an environmental temperature of approximately 26.7°C (80°F) A good approximation of the influence of temperature on energy needs is that for each one degree Celsius higher or lower average temperature, subtract or add about 2 kcal per bird per day respectively. (For each one degree of Fahrenheit change, subtract or add, about 1½ kcal per bird per day.)

age in wks.	g/bird/day	lb/100/day	kcal/bird/day	age in wks.	g/bird/day	lb/100/day	kcal/bird/day
17	67	14.8	208	49	100	22.0	281
18	72	15.9	212	50	100	22.0	281
19	78	17.2	230	51	100	22.0	281
20	82	18.1	236	52	100	22.0	281
21	86	19.0	250	53	100	22.0	281
22	88	19.4	259	54	100	22.0	281
23	90	19.8	265	55	100	22.0	281
24	92	20.3	271	56	100	22.0	281
25	92	20.3	274	57	101	22.3	281
26	95	20.9	276	58	101	22.3	281
27	96	21.2	279	59	101	22.3	281
28	97	21.4	279	60	101	22.3	281
29	97	21.4	279	61	101	22.3	281
30	98	21.6	279	62	101	22.3	281
31	98	21.6	279	63	101	22.3	281
32	98	21.6	279	64	101	22.3	282
33	98	21.6	279	65	101	22.3	282
34	98	21.6	279	66	101	22.3	282
35	98	21.6	279	67	101	22.3	282
36	98	21.6	279	68	102	22.5	283
37	98	21.6	279	69	102	22.5	283
38	98	21.6	279	70	102	22.5	283
39	98	21.6	279	71	102	22.5	283
40	98	21.6	279	72	102	22.5	283
41	98	21.6	279	73	102	22.5	283
42	99	21.8	280	74	102	22.5	284
43	99	21.8	280	75	102	22.5	284
44	99	21.8	280	76	102	22.5	284
45	99	21.8	280	77	102	22.5	284
46	100	22.0	280	78	102	22.5	284
47	100	22.0	280	79	102	22.5	285
48	100	22.0	281	80	103	22.7	285

Energy Management

Energy requirements of growing and laying flocks need to be determined and managed as other nutrients. Although birds do tend to adjust consumption to meet energy need, this is not always done precisely enough to insure optimum growth or performance. Additional energy in the feed can result in better body weight gain, egg production, and increased egg size, particularly when nutrients such as protein and amino acids are proportionally increased.

The energy need of layers under a moderate temperature range can be marginally estimated with the following equation:

$$\text{kcal/bird/day} = W(170 - 2.2T) + 2E + 5\,\Delta W$$

where W = current body weight in kilograms

T = average ambient temperature in degrees Celsius

E = daily egg mass in g/bird/day

$$\frac{(\%\ \text{production} \times \text{egg weight in grams})}{100}$$

Δ W = body weight gain in g/bird/day

Based on field experience, the Hy-Line W-98 layer may require slightly less energy than predicted by the equation.

The current energy consumption of a flock can be determined as follows:

$$\text{kcal/bird/day} = \frac{\text{kcal/lb feed} \times \text{lb/100 birds/day}}{100\ \text{birds}}$$

$$\text{kcal/bird/day} = \frac{\text{kcal/kg feed} \times \text{g/bird/day}}{1000}$$

Likewise, the calorie content needed in the feed to achieve a certain daily intake can be calculated as follows:

$$\text{kcal/lb feed} = \frac{\text{kcal/bird/day (desired)} \times 100}{\text{current lb/100 birds/day}}$$

$$\text{kcal/kg feed} = \frac{\text{kcal/bird/day (desired)} \times 1000}{\text{current g/bird/day}}$$

Increased nutrient density of the feed is useful at certain times, especially when energy consumption may be a limiting factor. This includes the critical period between housing and peak production. Flocks consuming less than 270–280 kcal/bird/day at peak production tend to suffer post-peak dips in production and reduced egg size. Heat stress will also result in lower feed and energy consumption. Increased nutrient density, to include energy (added fat) will typically help maintain production and egg size when environmental temperatures are high.

Fat is a concentrated source of energy which can be useful in increasing feed energy. The digestion of fat produces less body heat (lower heat increment), which is useful during periods of heat stress. Vegetable oils are typically high in linoleic acid which generally benefits egg size, although a blend of vegetable oil and animal fat may also be acceptable.

Water Consumption

Water consumption varies with temperature and feed consumption. A rule of thumb is that in the normal temperature range of bird comfort, 20–25°C (68–77°F), birds drink twice as much water as the feed eaten. The ratio changes as temperatures are higher because less feed is eaten and more water is consumed.

Water Consumption for Hy-Line W-98 Pullets and Layers
Water Consumed per 100 Birds

Chicks should consume 0.83 liters (0.22 gallons) per 100 birds on day one.

Age in Weeks	Liters	Gallons	Age in Weeks	Liters	Gallons
1	0.8–1.1	0.20–0.30	8	6.1–8.0	1.60–2.10
2	1.1–1.9	0.30–0.50	9	6.4–9.5	1.70–2.50
3	1.7–2.7	0.45–0.70	10–15	6.8–10.2	1.80–2.70
4	2.5–3.8	0.65–1.00	16–20	7.2–15.2	1.90–4.00
5	3.4–4.7	0.90–1.25	21–25*	9.9–18.2	2.60–4.80
6	4.5–5.7	1.20–1.50	Over 25*	15.2–20.8	4.00–5.50
7	5.7–6.8	1.50–1.80			

*Higher temperatures tend to elevate consumption by 1.9 liters (0.5 gallons) per 100 birds

Ventilation

Controlled ventilation can do a great deal to dilute pathogenic organisms as well as provide an optimum micro-environment when ventilation equipment is designed and operated to give correct air speed and direction.

A general rule for required fan capacity is four cubic meters of air movement per kilogram of body weight per hour (one cubic foot per minute per pound of body weight).

The birds' optimum environmental temperature and humidity is 21–27°C (70–80°F) and 40–60% relative humidity.

Suggested Minimum Ventilation Rates

CUBIC FEET PER MINUTE PER BIRD
AGE OF BIRDS

Outside Temperature	First Week	3 Wks.	6 Wks.	12 Wks.	18 Wks.	Beyond 18 Wks.
90°F	1.0	1.5	2.0	3.0	4.0	6.0–7.0
70°F	0.7	1.0	1.5	2.0	3.0	4.0–5.0
50°F	0.4	0.7	1.0	1.5	2.0	2.5–3.0
30°F	0.3	0.5	0.7	1.0	1.5	2.0–2.5
10°F	0.2	0.3	0.5	0.7	1.0	1.5–2.0
-10°F	0.1	0.2	0.3	0.5	0.5	1.0–1.5

CUBIC METERS PER HOUR PER BIRD
AGE OF BIRDS

Outside Temperature	First Week	3 Wks.	6 Wks.	12 Wks.	18 Wks.	Beyond 18 Wks.
35°C	2.0	3.0	4.0	6.0	8.0	12.0–14.0
20°C	1.4	2.0	3.0	4.0	6.0	8.0–10.0
10°C	0.8	1.4	2.0	3.0	4.0	5.0–6.0
0°C	0.6	1.0	1.5	2.0	3.0	4.0–5.0
-10°C	0.5	0.8	1.2	1.7	2.5	3.0–4.0
-20°C	0.3	0.6	0.9	1.2	1.5	2.0–3.0

Recommended Cage Densities for the Hy-Line W-98 Layer

	European Union Guidelines	U.S. Recommended (United Egg Producers)
Cage Space	450–550 cm² (70–85 sq in)	432–555 cm² (67–86 sq in)
Feeder Space	10 cm/bird (4 in/bird)	7.6 cm/bird (3 in/bird)
Water Space	access to 2 cups or nipples/cage	2 cups or nipples/12 birds or 1 in trough/bird

Non-Fast Molting

Many producers are now using programs to induce molting which do not involve fasting of the birds because of welfare concerns.

The Hy-Line W-98 will maintain good egg shell quality to 80 weeks of age and it may be best to continue egg production rather than inducing a molt. However, the Hy-Line W-98 bird will perform very well after a rest, particularly in the latter weeks of the molt cycle with excellent shell quality and persistency. The optimum age for molting is usually 65 weeks.

Induced molting can extend the productive life of a flock by improving rate of lay, shell quality and albumen height. However, these levels will be somewhat lower than the best premolt values. Egg size will remain essentially unaffected and will continue to increase after production resumes.

A flock can be induced to cease laying by a variety of methods. A welfare oriented non-fast molting method has been developed that results in post molt performance equivalent to that from fasting methods. Free access to water at all times during the non-fast molt is essential. It is important to know the sodium content of the drinking water. High sodium levels, 100 ppm+, can negate this type of molt program. Contact Hy-Line Technical Services for details.

Non-Fast Molting Recommendations

Molt Day	Light Hours	Feed Type	Feed Modification[1]	Feed Intake[2] g/b/d (lb/100/d)	House Temperature[3]	Comments
-7 to –5	16	Layer	Fine Lime	Full Feed	24–25°C (75–77°F)	**Fine Lime Diet:** Remove all coarse limestone and replace with fine limestone. DO NOT change the percent calcium in the diet.
-4 to –1	24	Layer	Fine Lime/ No Added Salt	Full Feed	24–25°C (75–77°F)	
0	6–8[4]	Molt 1 [5]	See Molt 1 diet	54–64 (12–14)	27–28°C (80–82°F)	Lower house temperatures may be needed to reduce body weight to 1.27–1.31 kg (2.8–2.9 lb).
1	6–8	Molt 1	Crude Fiber 12%	54–64 (12–14)	27-28°C (80-82°F)	
2	6–8	Molt 1		54–64 (12–14)	27–28°C (80–82°F)	
3	6–8	Molt 1		54–64 (12–14)	27–28°C (80–82°F)	
4	6–8	Molt 1		54–64 (12–14)	27–28°C (80–82°F)	
5	6–8	Molt 1		54–64 (12–14)	27–28°C (80–82°F)	
6	6–8	Molt 1		54–64 (12–14)	27–28°C (80–82°F)	
7 to 20	6–8	Molt 1		54–64 (12–14)	27–28°C (80–82°F)	Maintain 1.27–1.31 kg (2.8–2.9 lb) BW.
21 to 27	13	Molt 2		Full Feed	26–27°C (78–80°F)	Lower house temperatures as needed to increase feed consumption.
28 to 35 [6]	14	Molt 3		Full Feed	24–25°C (75–77°F)	
35+	15	Layer		Full Feed[7]		

(1) Probiotic or complex carbohydrate at 1 lb per ton (1/2 kg per metric ton) through all stages of the molt program.
(2) Feed intake depends on house temperature. Colder house temperatures may require more feed.
(3) Depends on air quality in the house. House temperatures may not be obtainable in cold weather.
(4) Set lights at 8 hours or natural day length in open-sided houses.
(5) Molt 1 feed is high fiber and no added salt.
(6) Increase lights 1 hour per week, up to 16 hours, starting on Day 28.
(7) According to diets in following table.

Layer Molt Minimum Nutrient Recommendations

Series	g/bird/day	lb/100/day	kcal/kg	% Protein	% Methionine	% Methionine + Cystine	% Lysine	% Threonine	% Tryptophan	% Arginine	% Calcium	% Avail. Phos.	% Sodium	% Chloride
Molt I	-	-	2600–2800	8.50	0.17	0.36	0.33	0.21	0.12	0.41	1.30	0.25	0.03[1]	0.03
Molt II	-	-	2750–2805	15.50	0.42	0.69	0.70	0.48	0.14	0.85	2.85	0.47	0.16	0.16
Molt III	-	-	2825–2900	16.50	0.36	0.60	0.75	0.50	0.15	0.88	4.00[2]	0.47	0.17	0.15
Peaking	85	19	2805–2950	18.25	0.41	0.67	0.96	0.65	0.19	1.04	5.35[2]	0.58	0.21	0.20
	90	20	2805–2950	17.25	0.39	0.64	0.91	0.62	0.18	0.99	5.05	0.55	0.20	0.19
	95	21	2805–2950	16.30	0.37	0.61	0.86	0.59	0.17	0.94	4.50	0.52	0.19	0.18
	100	22	2805–2950	15.50	0.35	0.58	0.82	0.55	0.16	0.90	4.30	0.50	0.18	0.17
	105	23	2805–2950	14.75	0.33	0.55	0.78	0.51	0.15	0.86	4.11	0.48	0.17	0.16
Post -	85	19	2750–2860	17.95	0.39	0.63	0.94	0.62	0.18	1.02	5.15[2]	0.52	0.21	0.20
	90	20	2750–2860	16.95	0.36	0.60	0.88	0.59	0.17	0.97	4.90	0.50	0.20	0.19
Peak A	95	21	2750–2860	16.05	0.34	0.57	0.84	0.56	0.16	0.92	4.66	0.47	0.19	0.18
	100	22	2750–2860	15.25	0.33	0.54	0.80	0.53	0.16	0.88	4.45	0.45	0.18	0.17
	105	23	2750–2860	14.50	0.31	0.51	0.76	0.50	0.15	0.84	4.26	0.43	0.17	0.16
Post -	90	20	2695–2860	16.65	0.35	0.58	0.86	0.57	0.16	0.95	5.06[2]	0.44	0.20	0.19
	95	21	2695–2860	15.75	0.33	0.55	0.81	0.54	0.16	0.90	4.82	0.42	0.19	0.18
Peak B	100	22	2695–2860	15.00	0.32	0.52	0.78	0.51	0.15	0.86	4.60	0.40	0.18	0.17
	105	23	2695–2860	14.30	0.30	0.50	0.74	0.48	0.14	0.82	4.60	0.38	0.17	0.16
	110	24	2695–2860	13.65	0.29	0.47	0.71	0.45	0.14	0.79	4.22	0.37	0.16	0.15
Post -	95	21	2695–2860	15.50	0.32	0.53	0.79	0.52	0.15	0.88	5.03[2]	0.37	0.19	0.18
	100	22	2695–2860	14.75	0.30	0.50	0.75	0.49	0.14	0.84	4.80	0.35	0.18	0.17
Peak C	105	23	2695–2860	14.05	0.29	0.48	0.71	0.46	0.14	0.80	4.59	0.33	0.17	0.16
	110	24	2695–2860	13.40	0.28	0.45	0.68	0.43	0.13	0.77	4.40	0.32	0.17	0.16
	115	25	2695–2860	12.85	0.26	0.43	0.65	0.40	0.13	0.74	4.22	0.31	0.16	0.15

(1) Maximum should be 0.005% greater than minimum, use lowest possible amounts.
(2) A minimum of 50% of the added limestone should have average particle size of at least 2–4 mm.

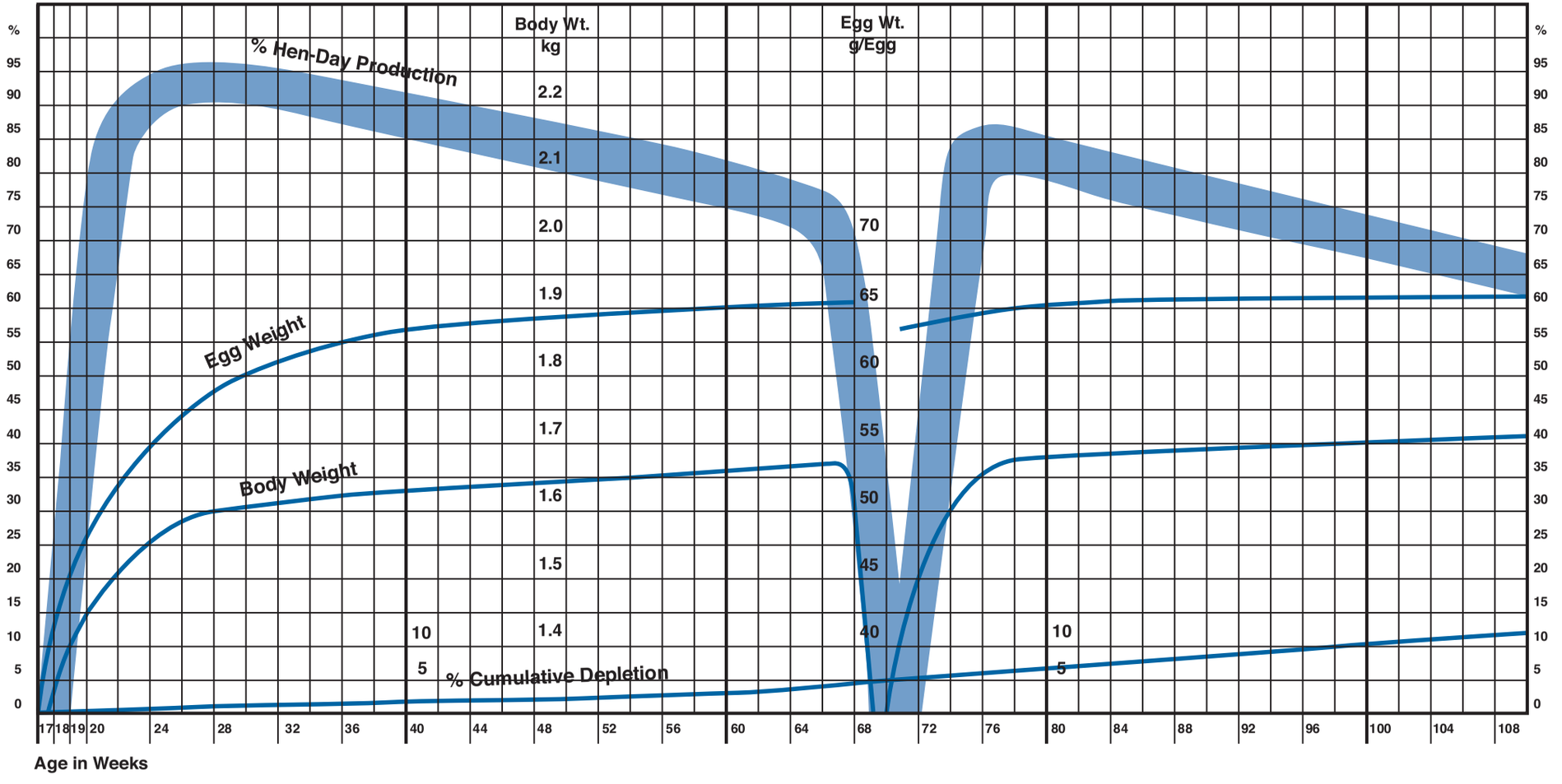
Hy-Line W-98 Post Molt Performance Table

Age in Weeks	% Hen-Day Lay Curr.	% Mortality Cum.	Hen-Day Cum.	Hen-Housed Cum.	Body Weight		Average Egg Weight*			% Grade A Large And Above		Egg Mass Cum.	
					kg	lb	g/egg	oz/doz.	Net lb/ 30 doz. case	24 oz/ doz.	23 oz/ doz.	kg	lb
68	44	4.6	289.5	284.0	1.67	3.68	65.5	27.7	52.0	90	92	17.8	39.3
69	0	4.9	289.5	284.0	1.33	2.93	-	-	-	-	-	17.8	39.3
70	0	5.1	289.5	284.0	1.27	2.80	-	-	-	-	-	17.8	39.3
71	5	5.3	289.8	284.4	1.44	3.18	63.0	26.7	50.0	87	93	17.8	39.3
72	22	5.4	291.4	285.8	1.51	3.32	63.4	26.9	50.3	88	93	17.9	39.5
73	52	5.5	295.0	289.3	1.56	3.44	63.7	27.0	50.6	89	93	18.1	40.0
74	77	5.6	300.4	294.4	1.61	3.55	63.9	27.1	50.7	89	93	18.5	40.7
75	80	5.7	306.0	299.6	1.64	3.62	64.1	27.2	50.9	90	93	18.8	41.5
76	83	5.8	311.8	305.1	1.66	3.66	64.3	27.2	51.0	90	94	19.2	42.4
77	84	6.0	317.7	310.6	1.67	3.68	64.5	27.3	51.2	90	93	19.6	43.3
78	83	6.1	323.5	316.1	1.67	3.69	64.6	27.4	51.3	90	93	20.0	44.0
79	82	6.2	329.2	321.5	1.67	3.69	64.7	27.4	51.3	90	93	20.3	44.8
80	81	6.3	334.9	326.8	1.68	3.70	64.7	27.4	51.3	90	93	20.7	45.6
81	80	6.5	340.5	332.0	1.68	3.70	64.7	27.4	51.3	90	93	21.1	46.4
82	80	6.6	346.1	337.2	1.68	3.70	64.8	27.4	51.4	90	93	21.4	47.2
83	79	6.8	351.6	342.4	1.68	3.70	64.8	27.4	51.4	90	93	21.8	48.0
84	79	6.9	357.2	347.6	1.68	3.71	64.8	27.4	51.4	90	93	22.1	48.8
85	79	7.1	362.7	352.7	1.68	3.71	64.8	27.4	51.4	89	93	22.5	49.6
86	78	7.2	368.2	357.8	1.68	3.71	64.9	27.5	51.5	89	93	22.9	50.4
87	78	7.4	373.6	362.8	1.68	3.71	64.9	27.5	51.5	89	92	23.2	51.2
88	78	7.5	379.1	367.9	1.68	3.71	64.9	27.5	51.5	89	92	23.6	52.0
89	77	7.7	384.5	372.8	1.69	3.72	65.0	27.5	51.6	89	92	23.9	52.7
90	76	7.9	389.8	377.7	1.69	3.72	65.0	27.5	51.6	89	92	24.3	53.5
91	76	8.0	395.1	382.6	1.69	3.72	65.0	27.5	51.6	89	92	24.6	54.3
92	75	8.2	400.4	387.5	1.69	3.72	65.1	27.6	51.7	89	92	24.9	55.0
93	75	8.4	405.6	392.3	1.69	3.72	65.1	27.6	51.7	88	92	25.3	55.8
94	74	8.6	410.8	397.0	1.69	3.72	65.1	27.6	51.7	88	92	25.6	56.5
95	74	8.8	416.0	401.7	1.69	3.73	65.2	27.6	51.7	88	92	26.0	57.3
96	74	9.0	421.2	406.4	1.69	3.73	65.2	27.6	51.7	88	91	26.3	58.0
97	73	9.2	426.3	411.1	1.69	3.73	65.2	27.6	51.7	88	91	26.6	58.7
98	73	9.4	431.4	415.7	1.69	3.73	65.2	27.6	51.7	88	91	27.0	59.5
99	72	9.6	436.4	420.3	1.69	3.73	65.3	27.7	51.8	88	91	27.3	60.2
100	72	9.8	441.5	424.8	1.69	3.73	65.3	27.7	51.8	88	91	27.6	60.9
101	71	10.0	446.4	429.3	1.69	3.73	65.3	27.7	51.8	87	91	28.0	61.6
102	70	10.3	451.3	433.7	1.70	3.74	65.3	27.7	51.8	87	91	28.3	62.3
103	70	10.5	456.2	438.1	1.70	3.74	65.4	27.7	51.9	87	91	28.6	63.0
104	70	10.7	461.1	442.4	1.70	3.74	65.4	27.7	51.9	87	90	28.9	63.8
105	70	11.0	466.0	446.8	1.70	3.74	65.4	27.7	51.9	87	90	29.2	64.5
106	69	11.2	470.9	451.1	1.70	3.74	65.4	27.7	51.9	87	90	29.5	65.2
107	69	11.5	475.7	455.4	1.70	3.74	65.5	27.7	52.0	87	90	29.9	65.9
108	68	11.7	480.4	459.6	1.70	3.74	65.5	27.7	52.0	87	90	30.2	66.5
109	68	12.0	485.2	463.7	1.70	3.74	65.6	27.8	52.1	86	89	30.5	67.2
110	67	12.3	489.9	467.9	1.70	3.75	65.6	27.8	52.1	86	89	30.8	67.9

*These egg weights are those which can be achieved through controlled feeding of protein. Larger egg sizes can be achieved by feeding higher protein levels.

Hy-Line® BRAND LAYERS

W-98 Hen-Day Performance Graph
Molted Flocks



Hy-Line W-98 Performance Table

Age in Weeks	Hen-Day		Mortality	Hen-Day Eggs		Hen-Housed Eggs		Body Weight		Average Egg Weight*			% Grade A Large And Above		Egg Mass Cum.		Egg Quality			
	Curr. Under Opt. Cond's.	Curr. Under Avg. Cond's.	% Cum.	Cum. Under Opt. Cond's.	Cum. Under Avg. Cond's.	Cum. Under Opt. Cond's.	Cum. Under Avg. Cond's.	kg	lb	g/egg	oz/doz.	Net lb/ 30 doz. case	24 oz/ doz.	23 oz/ doz.	kg	lb	Haugh Units	Shell Thickness mm	Breaking Strength	% Solids
18	14	12	0.1	1.0	0.8	1.0	0.8	1.32	2.91	41.8	17.7	33.2	-	-	0.0	0.1	98.2	0.360	4520	22.0
19	35	33	0.1	3.4	3.2	3.4	3.1	1.39	3.07	45.6	19.3	36.2	2	5	0.1	0.3	98.0	0.359	4515	22.3
20	59	57	0.2	7.6	7.1	7.5	7.1	1.45	3.20	47.9	20.3	38.0	5	12	0.3	0.7	97.8	0.358	4500	22.5
21	78	76	0.2	13.0	12.5	13.0	12.4	1.49	3.29	49.9	21.1	39.6	11	21	0.6	1.3	97.2	0.357	4500	22.9
22	87	85	0.3	19.1	18.4	19.1	18.4	1.52	3.35	51.6	21.9	41.0	18	31	0.9	2.0	97.0	0.356	4490	22.9
23	92	90	0.4	25.6	24.7	25.5	24.6	1.54	3.40	53.4	22.6	42.4	28	42	1.2	2.7	96.5	0.356	4485	23.1
24	92	90	0.4	32.0	31.0	31.9	30.9	1.56	3.44	54.4	23.0	43.2	33	49	1.6	3.5	96.0	0.355	4480	23.3
25	93	91	0.5	38.5	37.4	38.4	37.3	1.57	3.47	55.8	23.6	44.3	42	58	1.9	4.3	95.5	0.354	4475	23.4
26	93	91	0.5	45.0	43.8	44.8	43.6	1.58	3.49	56.7	24.0	45.0	48	63	2.3	5.1	95.1	0.354	4470	23.5
27	93	92	0.6	51.5	50.2	51.3	50.0	1.59	3.51	57.5	24.4	45.6	53	68	2.7	5.9	94.7	0.353	4465	23.6
28	94	92	0.7	58.1	56.6	57.8	56.4	1.60	3.52	58.4	24.7	46.3	60	74	3.0	6.7	94.2	0.352	4460	23.6
29	94	93	0.7	64.7	63.1	64.4	62.8	1.60	3.53	59.0	25.0	46.8	64	77	3.4	7.6	93.7	0.352	4455	23.7
30	94	93	0.8	71.3	69.7	70.9	69.3	1.61	3.54	59.5	25.2	47.2	67	80	3.8	8.4	93.3	0.351	4450	23.7
31	93	93	0.8	77.8	76.2	77.4	75.8	1.61	3.55	59.8	25.3	47.5	69	82	4.2	9.2	92.8	0.350	4440	23.8
32	93	92	0.9	84.3	82.6	83.8	82.1	1.61	3.55	60.1	25.5	47.7	72	84	4.6	10.1	92.2	0.350	4440	23.8
33	92	91	1.0	90.7	89.0	90.2	88.4	1.61	3.56	60.4	25.6	47.9	74	85	4.9	10.9	92.0	0.349	4430	23.9
34	92	91	1.0	97.2	95.3	96.6	94.7	1.61	3.56	60.6	25.7	48.1	76	87	5.3	11.8	91.5	0.348	4430	23.9
35	91	90	1.1	103.5	101.6	102.9	101.0	1.62	3.57	61.0	25.8	48.4	79	89	5.7	12.6	91.1	0.348	4420	24.0
36	91	90	1.1	109.9	107.9	109.2	107.2	1.62	3.57	61.3	26.0	48.7	82	91	6.1	13.4	90.6	0.347	4400	24.0
37	91	89	1.2	116.3	114.2	115.4	113.4	1.62	3.58	61.6	26.1	48.9	84	92	6.5	14.3	90.4	0.346	4400	24.2
38	90	89	1.3	122.6	120.4	121.7	119.5	1.62	3.58	61.9	26.2	49.1	86	94	6.9	15.1	90.0	0.346	4395	24.2
39	90	88	1.3	128.9	126.6	127.9	125.6	1.63	3.59	62.1	26.3	49.3	87	94	7.2	15.9	89.6	0.345	4395	24.5
40	90	88	1.4	135.2	132.7	134.1	131.7	1.63	3.59	62.3	26.4	49.4	88	94	7.6	16.8	89.3	0.344	4390	24.5
41	89	87	1.5	141.4	138.8	140.2	137.7	1.63	3.60	62.6	26.5	49.7	89	95	8.0	17.6	88.9	0.344	4350	24.5
42	89	87	1.6	147.6	144.9	146.4	143.7	1.63	3.60	62.8	26.6	49.8	89	95	8.4	18.4	88.5	0.343	4350	24.5
43	88	87	1.6	153.8	151.0	152.4	149.6	1.64	3.61	63.0	26.7	50.0	89	95	8.7	19.3	88.0	0.342	4320	24.5
44	87	86	1.7	159.9	157.0	158.4	155.6	1.64	3.61	63.3	26.8	50.2	90	95	9.1	20.1	87.8	0.342	4320	24.5
45	87	86	1.8	166.0	163.0	164.4	161.5	1.64	3.62	63.6	26.9	50.5	91	95	9.5	20.9	87.4	0.341	4290	24.5
46	86	85	1.9	172.0	169.0	170.3	167.3	1.64	3.62	63.8	27.0	50.6	91	95	9.9	21.7	87.1	0.340	4290	24.4
47	86	85	2.0	178.0	174.9	176.2	173.1	1.64	3.62	63.8	27.0	50.6	91	95	10.2	22.6	86.7	0.339	4265	24.4
48	85	85	2.1	184.0	180.9	182.0	179.0	1.65	3.63	64.0	27.1	50.8	91	95	10.6	23.4	86.4	0.339	4265	24.4
49	85	84	2.1	189.9	186.8	187.8	184.7	1.65	3.63	64.0	27.1	50.8	91	95	11.0	24.2	86.1	0.338	4220	24.4
50	85	84	2.2	195.9	192.6	193.7	190.5	1.65	3.63	64.1	27.2	50.9	91	95	11.3	25.0	85.6	0.337	4200	24.4

*Egg weights after 40 weeks of age assume phase feeding of protein to limit egg size.

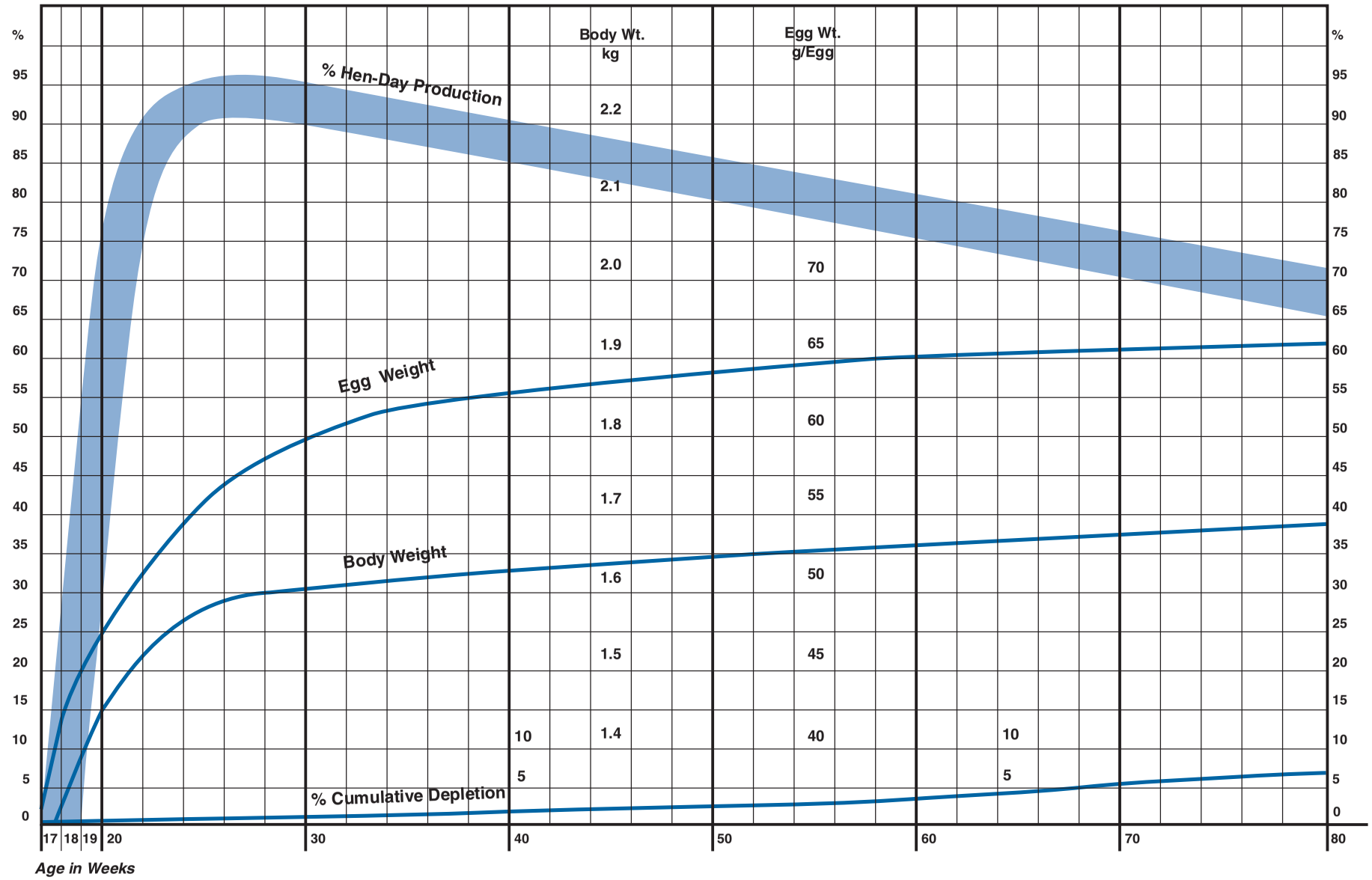
Hy-Line W-98 Performance Table

Age in Weeks	Hen-Day		Mortality	Hen-Day Eggs		Hen-Housed Eggs		Body Weight		Average Egg Weight*			% Grade A Large And Above		Egg Mass Cum.		Egg Quality			
	Curr. Under Opt. Cond's.	Curr. Under Avg. Cond's.	% Cum.	Cum. Under Opt. Cond's.	Cum. Under Avg. Cond's.	Cum. Under Opt. Cond's.	Cum. Under Avg. Cond's.	kg	lb	g/egg	oz/doz.	Net lb/ 30 doz. case	24 oz/ doz.	23 oz/ doz.	kg	lb	Haugh Units	Shell Thickness mm	Breaking Strength	% Solids
51	84	83	2.3	201.7	198.5	199.4	196.1	1.65	3.64	64.2	27.2	51.0	91	95	11.7	25.8	85.0	0.337	4190	24.4
52	84	83	2.4	207.6	204.3	205.1	201.8	1.65	3.64	64.3	27.2	51.0	90	94	12.1	26.6	85.0	0.336	4190	24.4
53	84	82	2.5	213.5	210.0	210.9	207.4	1.65	3.64	64.4	27.3	51.1	90	94	12.4	27.4	84.8	0.335	4160	24.4
54	83	82	2.7	219.3	215.7	216.5	213.0	1.65	3.64	64.5	27.3	51.2	90	94	12.8	28.2	84.6	0.335	4160	24.4
55	83	81	2.8	225.1	221.4	222.2	218.5	1.66	3.65	64.6	27.4	51.3	90	94	13.1	29.0	84.3	0.334	4100	24.4
56	83	81	2.9	230.9	227.1	227.8	224.0	1.66	3.65	64.8	27.4	51.4	90	94	13.5	29.8	84.0	0.333	4100	24.3
57	82	80	3.0	236.7	232.7	233.4	229.4	1.66	3.65	64.8	27.4	51.4	90	93	13.9	30.6	83.8	0.333	4095	24.3
58	82	80	3.1	242.4	238.3	238.9	234.9	1.66	3.65	64.8	27.4	51.4	90	93	14.2	31.3	83.1	0.332	4095	24.3
59	81	79	3.3	248.1	243.8	244.4	240.2	1.66	3.66	64.9	27.5	51.5	90	93	14.6	32.1	82.8	0.331	4090	24.3
60	81	78	3.4	253.8	249.3	249.9	245.5	1.66	3.66	65.0	27.5	51.6	89	93	14.9	32.8	82.6	0.331	4080	24.3
61	80	77	3.5	259.4	254.7	255.3	250.7	1.66	3.66	65.1	27.6	51.7	89	93	15.2	33.6	82.4	0.330	4080	24.3
62	80	77	3.7	265.0	260.1	260.7	255.9	1.66	3.66	65.2	27.6	51.7	89	93	15.6	34.3	82.2	0.329	4065	24.3
63	79	76	3.8	270.5	265.4	266.0	261.0	1.66	3.67	65.3	27.7	51.8	89	92	15.9	35.1	82.0	0.329	4065	24.3
64	79	76	4.0	276.0	270.7	271.3	266.1	1.66	3.67	65.3	27.7	51.8	89	92	16.2	35.8	81.9	0.328	4055	24.2
65	78	75	4.1	281.5	275.9	276.6	271.1	1.66	3.67	65.4	27.7	51.9	89	92	16.6	36.5	81.8	0.327	4050	24.2
66	78	75	4.3	286.9	281.2	281.8	276.2	1.66	3.67	65.4	27.7	51.9	89	92	16.9	37.3	81.6	0.327	4005	24.2
67	77	74	4.4	292.3	286.4	286.9	281.1	1.66	3.67	65.5	27.7	52.0	89	92	17.2	38.0	81.5	0.326	4005	24.2
68	76	74	4.6	297.6	291.6	292.0	286.0	1.67	3.68	65.5	27.7	52.0	89	92	17.5	38.7	81.5	0.325	3990	24.2
69	76	74	4.8	303.0	296.7	297.1	291.0	1.67	3.68	65.5	27.7	52.0	89	92	17.9	39.4	81.3	0.325	3990	24.2
70	75	73	4.9	308.2	301.8	302.1	295.8	1.67	3.68	65.6	27.8	52.1	89	92	18.2	40.1	81.1	0.324	3965	24.2
71	74	73	5.1	313.4	307.0	307.0	300.7	1.67	3.68	65.6	27.8	52.1	88	92	18.5	40.8	81.1	0.323	3965	24.2
72	74	72	5.3	318.6	312.0	311.9	305.5	1.67	3.68	65.6	27.8	52.1	88	91	18.8	41.5	81.0	0.322	3945	24.2
73	73	72	5.4	323.7	317.0	316.7	310.2	1.67	3.69	65.6	27.8	52.1	88	91	19.1	42.2	80.9	0.322	3945	24.2
74	73	71	5.6	328.8	322.0	321.5	314.9	1.67	3.69	65.7	27.8	52.1	88	91	19.4	42.9	80.8	0.321	3930	24.2
75	72	71	5.8	333.8	327.0	326.3	319.6	1.67	3.69	65.7	27.8	52.1	88	91	19.7	43.5	80.7	0.320	3930	24.2
76	72	70	6.0	338.9	331.9	331.0	324.2	1.67	3.69	65.8	27.9	52.2	88	91	20.1	44.2	80.5	0.320	3920	24.2
77	71	70	6.2	343.8	336.8	335.7	328.8	1.67	3.69	65.8	27.9	52.2	88	91	20.4	44.9	80.4	0.319	3920	24.2
78	71	69	6.3	348.8	341.6	340.3	333.3	1.68	3.70	65.8	27.9	52.2	88	91	20.7	45.5	80.2	0.318	3900	24.1
79	70	69	6.5	353.7	346.4	344.9	337.8	1.68	3.70	65.9	27.9	52.3	88	91	20.9	46.2	80.1	0.318	3900	24.1
80	70	69	6.7	358.6	351.3	349.5	342.3	1.68	3.70	65.9	27.9	52.3	88	91	21.2	46.8	80.0	0.317	3900	24.1

*Egg weights after 40 weeks of age assume phase feeding of protein to limit egg size.

Hy-Line® BRAND LAYERS

W-98 Hen-Day Performance Graph



Egg Size Distribution—U.S. Standards

Age in Weeks	Average Egg Weight lb/case	Jumbo Over 30 oz/doz.	Extra Large 27–30 oz/doz.	Large 24–27 oz/doz.	Medium 21–24 oz/doz.	Small 18–21 oz/doz.	Peewee Under 18 oz/doz.
22	41.0	0.0	1.7	17.1	45.2	30.0	5.9
24	43.2	0.3	5.3	29.3	44.4	18.6	2.2
26	45.0	0.8	10.7	38.5	38.6	10.6	0.8
28	46.3	1.4	15.8	44.5	32.1	5.9	0.3
30	47.2	1.9	19.8	47.7	26.9	3.5	0.1
32	47.7	2.1	22.2	49.6	23.7	2.3	0.1
34	48.1	2.2	24.1	52.0	20.4	1.4	0.0
36	48.7	2.2	27.6	53.7	15.8	0.6	0.0
38	49.1	2.2	31.9	54.0	11.6	0.3	0.0
40	49.4	2.8	34.2	52.3	10.5	0.2	0.0
42	49.8	3.6	37.7	49.9	8.6	0.2	0.0
44	50.2	5.0	40.8	46.7	7.4	0.2	0.0
46	50.6	6.6	43.5	43.4	6.4	0.1	0.0
48	50.8	7.2	44.2	42.2	6.4	0.1	0.0
50	50.9	7.9	44.7	41.3	6.0	0.1	0.0
52	51.0	9.0	45.2	39.8	5.9	0.1	0.0
54	51.2	10.1	45.7	38.4	5.7	0.1	0.0
56	51.4	11.2	46.5	36.7	5.5	0.1	0.0
58	51.4	11.5	46.5	36.4	5.5	0.1	0.0
60	51.6	12.7	46.6	35.2	5.4	0.1	0.0
62	51.7	13.7	46.9	34.2	5.1	0.1	0.0
64	51.8	14.4	46.9	33.5	5.1	0.1	0.0
66	51.9	15.0	46.9	33.0	5.0	0.1	0.0
68	52.0	16.0	46.5	32.5	5.0	0.1	0.0
70	52.1	16.9	46.1	32.0	5.0	0.1	0.0
72	52.1	16.9	46.1	32.0	5.0	0.1	0.0
74	52.1	17.9	45.6	31.5	5.0	0.1	0.0
76	52.2	18.3	45.8	30.9	5.0	0.1	0.0
78	52.2	18.7	45.7	30.7	4.9	0.1	0.0
80	52.3	19.2	45.4	30.3	4.9	0.1	0.0

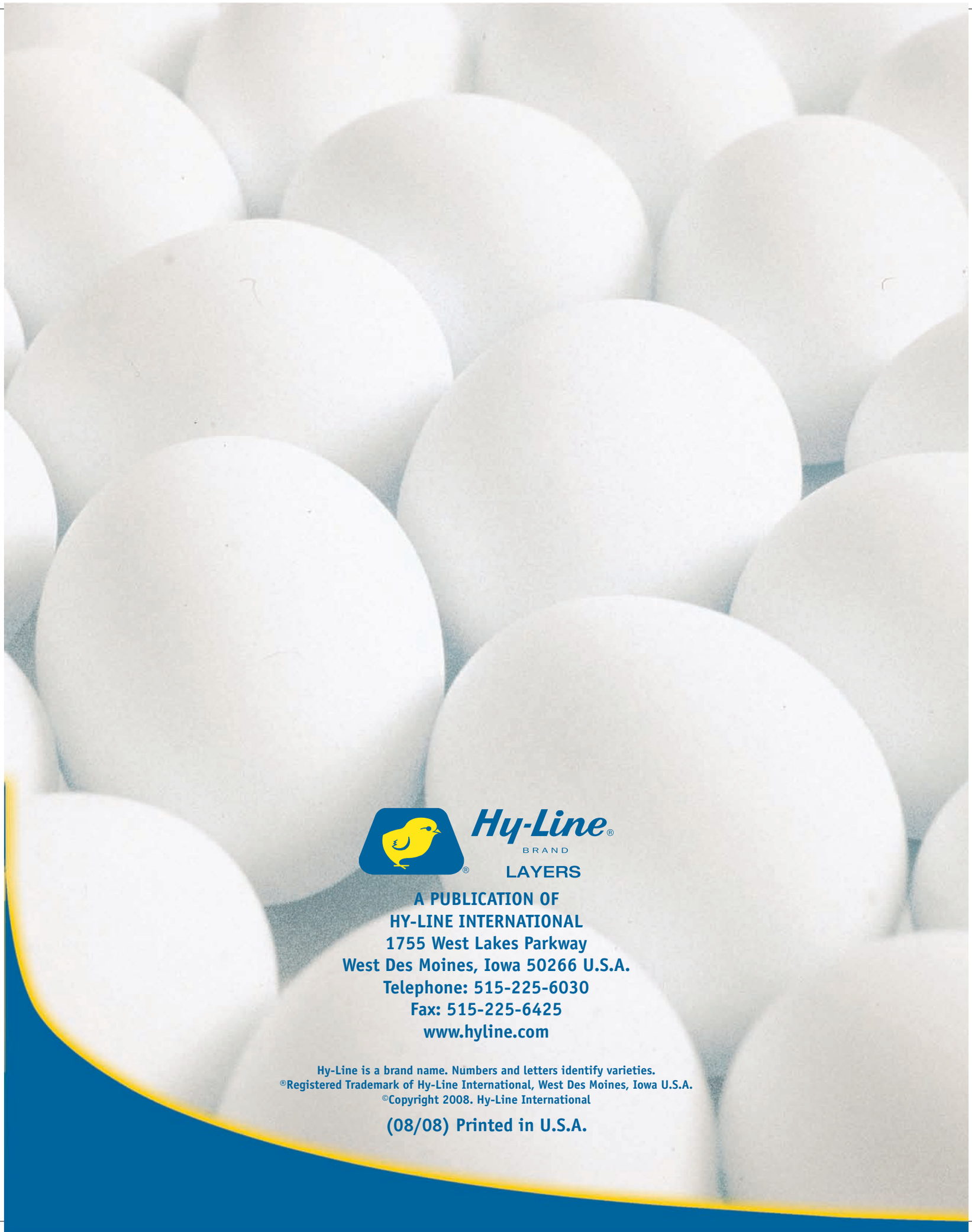
Egg Size Distribution—E.U. Standards

Age in Weeks	Average Egg Weight g	Very Large Over 73 g	Large 63–73 g	Medium 53–63 g	Small 43–53 g
22	51.6	0.0	2.5	38.0	59.5
24	54.4	0.1	7.2	52.1	40.6
26	56.7	0.3	14.0	59.2	26.5
28	58.4	0.5	20.5	61.8	17.2
30	59.5	0.7	25.5	61.9	11.8
32	60.1	0.8	28.5	61.8	9.0
34	60.6	0.8	31.4	61.3	6.4
36	61.3	0.9	35.2	60.1	3.8
38	61.9	0.9	39.3	57.6	2.2
40	62.3	1.0	43.0	54.2	1.8
42	62.8	1.2	47.1	50.3	1.5
44	63.3	1.8	50.9	46.1	1.3
46	63.8	2.5	54.2	42.2	1.1
48	64.0	2.8	55.1	41.0	1.1
50	64.1	3.2	55.9	39.9	1.0
52	64.3	3.8	56.7	38.5	1.0
54	64.5	4.5	57.4	37.2	1.0
56	64.8	5.1	58.5	35.5	1.0
58	64.8	5.6	58.9	34.5	1.0
60	65.0	6.2	59.0	33.9	1.0
62	65.2	6.7	59.7	32.7	1.0
64	65.3	7.3	59.8	32.0	1.0
66	65.4	7.6	59.9	31.6	1.0
68	65.5	8.3	59.6	31.1	1.0
70	65.6	9.0	59.3	30.8	0.9
72	65.6	9.1	59.2	30.7	0.9
74	65.7	9.5	59.2	30.4	0.9
76	65.8	10.1	58.9	30.1	0.9
78	65.8	10.6	58.6	29.9	0.9
80	65.9	10.8	58.6	29.8	0.9

Feed Ingredient Analysis Table[1,2,3]

Ingredient	M.E. kcal/lb	M.E. kcal/kg	% Crude Protein	% Calcium	% Phos Avail.	% Sodium	% Chloride	% Arginine	% Lysine	% Methionine	% Methionine + Cystine	% Threonine	% Tryptophan	% Crude Fat
Alfalfa Meal	740	1630	20.0	1.50	0.27	0.08	0.47	0.98	0.87	0.33	0.56	0.88	0.46	3.5
Barley	1250	2750	11.5	0.08	0.15	0.03	0.14	0.50	0.53	0.18	0.43	0.36	0.36	1.9
Canola Meal	960	2110	38.0	0.68	0.30	—	—	2.30	2.02	0.77	1.74	1.50	0.46	3.8
Corn, Yellow, Grain	1540	3390	7.50	0.01	0.09	0.02	0.04	0.40	0.24	0.18	0.36	0.29	0.07	3.5
Corn Gluten Meal	1700	3740	60.0	0.02	0.18	0.03	0.05	1.90	1.00	1.90	3.00	2.00	0.30	2.0
Corn Distillers DGS	1270	2800	27.0	0.14	0.55	0.20	0.17	1.10	0.80	0.51	1.01	0.92	0.20	9.0
Fat, Vegetable	4000	8900	0.00	—	—	—	—	—	—	—	—	—	—	98.0
Fat, Animal	3600	7920	0.00	—	—	—	—	—	—	—	—	—	—	98.0
Fish Meal, Anchovy	1280	2820	65.0	4.00	2.85	0.88	0.90	3.38	4.90	1.90	2.50	2.70	0.75	10.0
Rice, Grain	1335	2940	7.30	0.04	0.09	0.04	0.06	0.59	0.24	0.14	0.22	0.27	0.12	1.7
Safflower Meal	925	2040	42.0	0.40	0.37	0.04	0.16	3.70	1.30	0.69	1.39	1.35	0.60	1.3
Sorghum	1505	3310	11.0	0.04	0.10	0.03	0.09	0.40	0.27	0.10	0.30	0.27	0.09	2.8
Soybean Meal	1115	2458	47.8	0.20	0.21	0.04	0.02	3.60	3.02	0.70	1.41	2.00	0.70	1.0
Sunflower Meal	1025	2260	34.0	0.30	0.27	0.20	0.01	2.80	1.42	0.64	1.14	1.48	0.35	0.5
Wheat, Hard	1440	3170	13.5	0.05	0.12	0.06	0.07	0.60	0.40	0.25	0.55	0.35	0.18	1.9
Wheat, Soft	1460	3210	10.8	0.05	0.11	0.06	0.07	0.40	0.30	0.14	0.34	0.28	0.12	1.7
Calcium Carbonate ($CaCO_3$)	—	—	—	38.0	—	—	—	—	—	—	—	—	—	—
Monocalcium Phosphate	—	—	—	16.0	21.0	—	—	—	—	—	—	—	—	—
Dicalcium Phosphate	—	—	—	20.5	18.5	—	—	—	—	—	—	—	—	—
Salt (NaCl)	—	—	—	—	—	39.5	59.8	—	—	—	—	—	—	—

(1) Ingredient analysis values are from Feedstuffs Reference Issue & Buyer Guide 2007.
(2) Formula nutrient profile recommendations (pages 13 and 14) are based on calculations using these ingredient nutrient values.
(3) Feed ingredient analysis values can vary region. Use local values when formulating feed.



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