Hy-Line

2014

Management Guide

COMMERCIAL LAYERS

Hy-Line®

BROWN

USE OF THE MANAGEMENT GUIDE

The genetic potential of Hy-Line Brown Commercial can only be realized if good poultry husbandry practices and management are used. This management guide outlines successful flock management programs for Hy-Line Variety Brown Commercial based on field experience compiled by Hy-Line International and using an extensive commercial layer flock database of Hy-Line flocks from all parts of the world. Hy-Line International management recommendations and principles taken from industry technical literature are available in the Hy-Line Red Book, an *Online Management Guide*, which is found at www.hylineredbook.com. Hy-Line International Management Guides are periodically updated as new performance data and/or nutrition information become available.

The information and suggestions contained in this management guide should be used for guidance and educational purposes only, recognizing that local environmental and disease conditions may vary and a guide cannot cover all possible circumstances. While every attempt has been made to ensure that the information presented is accurate and reliable at the time of publication, Hy-Line International cannot accept responsibility for any errors, omissions or inaccuracies in such information or management suggestions. Further, Hy-Line International does not warrant or make any representations or guarantees regarding the use, validity, accuracy, or reliability of, or flock performance or productivity resulting from the use of, or otherwise respecting, such information or management suggestions. In no event shall Hy-Line International be liable for any special, indirect or consequential damages or special damages whatsoever arising out of or in connection with the use of the information or management suggestions contained in this management guide.

TABLE OF CONTENTS

Summary of Performance Standards 1
Transportation to Farm 2
Cage Brooding 2
Brooding Recommendations 3
Lighting During Brooding Period 4
Drinking Systems 4
Beak Treatment / Trimming 5
Layer Growth and Development 6
Growing Body Weights, Feed Consumption and Uniformity 7
Space Guidelines 7
Cage Systems Management 7
Management Events for Commercial Layers 8–9
Good Lighting Practices 10
Light Program for Light-Controlled Housing 10
Customized Lighting Programs for Open-Sided Housing . . 11
Lighting Considerations 12
Use of Shades in Open-Sided Housing 12
Midnight Feeding / Lighting Program 12
Water Quality 13
Water Consumption 14
Air Quality 14
Calcium Particle Size 14
Feed Particle Size 15
Vitamins and Trace Minerals 15
Phase Feeding to Meet the Hen's Nutritional Needs 16
Growing Period Nutritional Recommendations 17
Transition Period from Grow to Peak Egg Production 18
Production Period Nutritional Recommendations 19
Dietary Nutrient Concentrations for Production Period . . . 20
Non-Fast Molting Recommendations 21
Molt Diet Recommendations 22
Post-Molt Nutrition Recommendations 23
Disease Control 24
Vaccination Recommendations 25–27
Performance Standards 28–29
Performance Standards Graph 30
Post-Molt Performance Standards 31
Post-Molt Performance Standards Graph 32
Egg Quality Standards 33
Egg Size Standards 33–34
Egg Size Standards Graphs 35
Feed Ingredient Tables 36–37

Summary of Performance Standards

GROWING PERIOD (TO 17 WEEKS):	
Livability	98%
Feed Consumed	5.75–6.13 kg
Body Weight at 17 Weeks	1.40–1.48 kg
LAYING PERIOD (TO 110 WEEKS):	
Percent Peak	95–96%
Hen-Day Eggs to 60 Weeks Hen-Day Eggs to 90 Weeks	257–266 419–432
Hen-Housed Eggs to 60 Weeks Hen-Housed Eggs to 90 Weeks Hen-Housed Eggs to 110 Weeks	253–262 408–421 491–508
Livability to 60 Weeks Livability to 90 Weeks	97% 93%
Days to 50% Production (from hatch)	140 days
Egg Weight at 26 Weeks Egg Weight at 32 Weeks Egg Weight at 70 Weeks	57.3–59.7 g / egg 60.1–62.5 g / egg 62.9–65.5 g / egg
Total Egg Mass per Hen-Housed (18–90 weeks)	25.5 kg
Body Weight at 32 Weeks Body Weight at 70 Weeks	1.85–1.97 kg 1.91–2.03 kg
Freedom From Egg Inclusions	Excellent
Shell Strength	Excellent
Shell Color at 38 Weeks Shell Color at 56 Weeks Shell Color at 70 Weeks	87 85 81
Haugh Units at 38 Weeks Haugh Units at 56 Weeks Haugh Units at 70 Weeks	90.0 84.0 81.1
Average Daily Feed Consumption (18–90 weeks)	105–112 g / day per bird
Feed Conversion Rate, kg Feed/kg Eggs (20–60 weeks) Feed Conversion Rate, kg Feed/kg Eggs (20–90 weeks)	1.87–1.99 1.95–2.07
Feed Utilization, kg Egg/kg Feed (20–60 weeks) Feed Utilization, kg Egg/kg Feed (20–90 weeks)	0.50–0.54 0.48–0.51
Feed per Dozen Eggs (20–60 weeks) Feed per Dozen Eggs (20–90 weeks)	1.42–1.46 kg 1.51–1.55 kg
Skin Color	Yellow
Condition of Droppings	Dry

Performance Summary data is based on results obtained from customers around the world. Please send your results to info@hyline.com. An easy to use record-keeping program, ***Hy-Line International EggCel****, can be found at www.hylineeggcel.com*

Transportation to Farm

Transportation

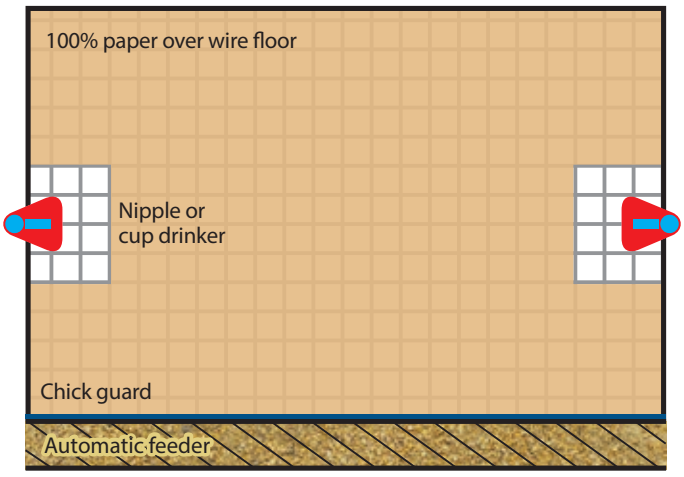
- Use truck designed for transportation of chicks from hatchery to farm
- Truck should be environmentally controlled, maintaining 30–32°C at 70% relative humidity (measured inside chick box); minimum air flow of 0.7 m^3 per minute
- Provide space between stacks of chick boxes for air flow

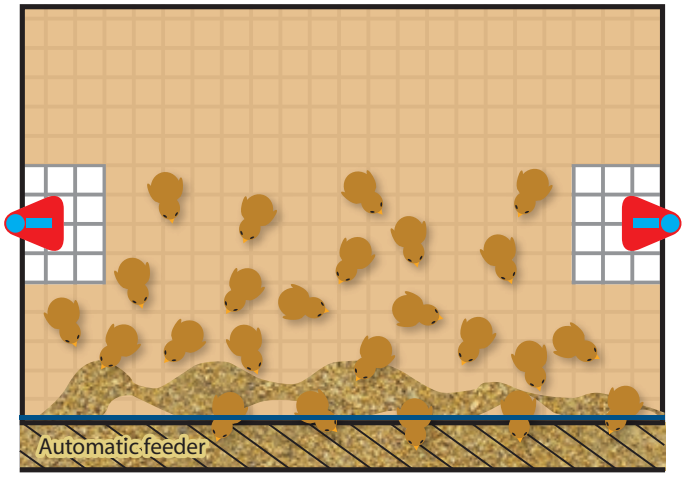
Chick Placement

- Unload boxes quickly and gently place chicks in brooding area
- Brood chicks in groups from similar aged breeder flocks

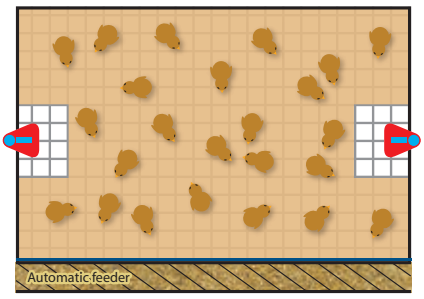
Cage Brooding

- Brooder house should be completely cleaned and disinfected well in advance of chick delivery. Confirm effectiveness of cleaning and disinfection with environmental swabs
- Allow 2 weeks minimum downtime between flocks
- Start chicks in upper tiered cages which are usually warmer and brighter
- For more information on house preparation and brooding management, see www.hylinepullet.com
- Pre-heat brooding area at least 24 hours prior to chick arrival to warm concrete floors and house equipment
- Place feed on cage paper 0–3 days to encourage consumption
- Place feed in front of permanent feeder to train chicks to move towards feeders
- Fill automatic feed line to its highest level and adjust chick guards
- Remove paper by 14 days of age to avoid build-up of feces
- Cage floors should not be slippery or sloped
- Use vitamins and electrolytes in chicks' water (avoid sugar-based products to prevent growth of microorganisms)

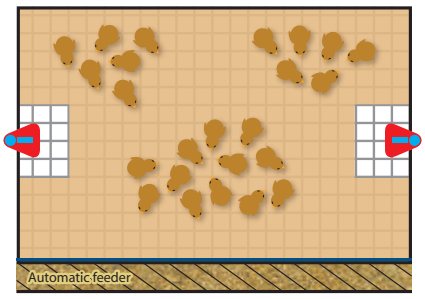




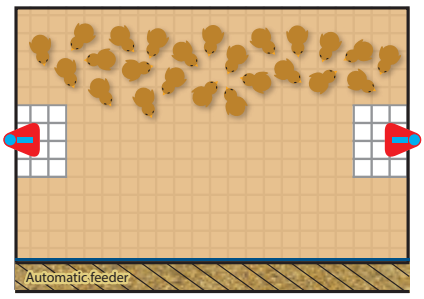
Place feed on paper near automatic feeder to train chicks



CORRECT
Chicks evenly distributed in brooding area, active and sounding content



COLD
Chicks gathered into groups sounding distressed



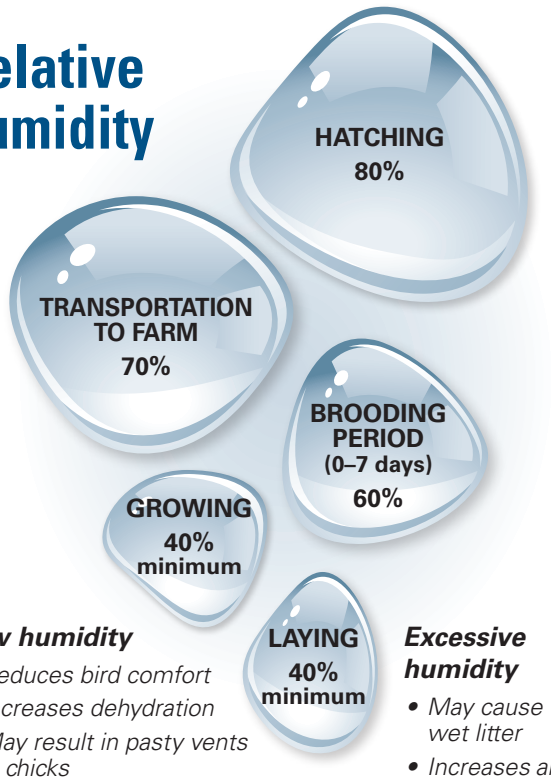
UNEVEN VENTILATION
Chicks avoiding drafts, noise or uneven light distribution; congregating in one part of cage

Brooding Recommendations

- Brood chicks in groups from similar aged breeder flocks
- Modify temperature as needed to meet chicks' comfort needs
- Adjust brooding temperature according to relative humidity. Lower temperature can be used with higher relative humidity
- Establish proper house temperature and humidity 24 hours before chick placement; floor temperature should be 32°C
- Bright light (30–50 lux) during 0–7 days helps chicks quickly find feed and water and adapt to new environment
- After first week, reduce temperature weekly 2–3°C until reaching 21°C

AGE	0–3 days	4–7 days	8–14 days	15–21 days	22–28 days	29–35 days	36+ days
CAGE	33–36°C	30–32°C	28–30°C	26–28°C	23–26°C	21–23°C	21°C
LIGHT INTENSITY	30–50 lux	30–50 lux	25 lux	25 lux	25 lux	10–15 lux	10–15 lux
LIGHT HOURS	23 hours or Intermittent Program	21 hours or Intermittent Program	19 hours	17 hours	15 hours	13.5 hours	12 hours

Relative humidity



Low humidity

- *Reduces bird comfort*
- *Increases dehydration*
- *May result in pasty vents in chicks*
- *May increase agitation and possibility of pecking*
- *Adversely affects feather cover*
- *Increases dust*

Excessive humidity

- *May cause wet litter*
- *Increases ammonia*
- *Causes poor air quality*

CROP FILL – ARE THE CHICKS EATING?

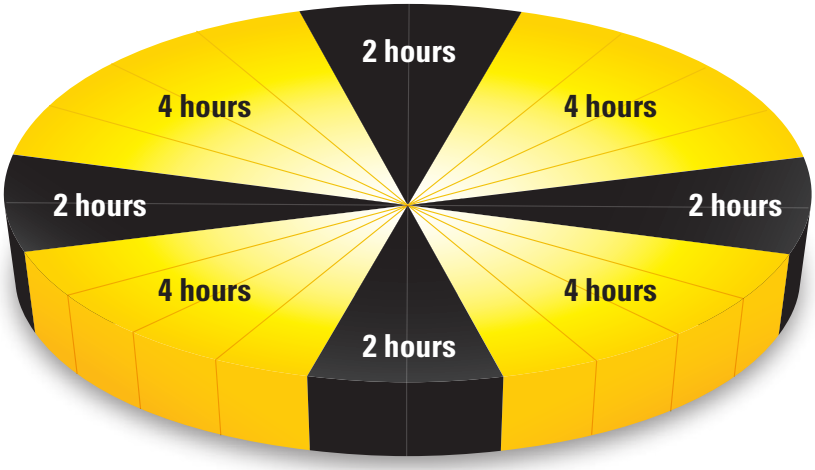
Hours after chick placement	Chicks with feed in crop
6	75%
12	85%
24	100%

Chick with starter feed in crop | *Chick without starter feed in crop*

Lighting During Brooding Period

- Chicks should have 23 hours of light / 1 hour of dark for days 0–3 and 21 hours of light for days 4–7 to help chicks find feed and water. An intermittent light program for chicks is a good alternative (see below)
- Do not use 24 hours of light
- Bright light (30–50 lux) during 0–7 days helps chicks quickly find feed and water and adapt to new environment
- After first week, begin slow step-down lighting program (see Light-Controlled Houses)

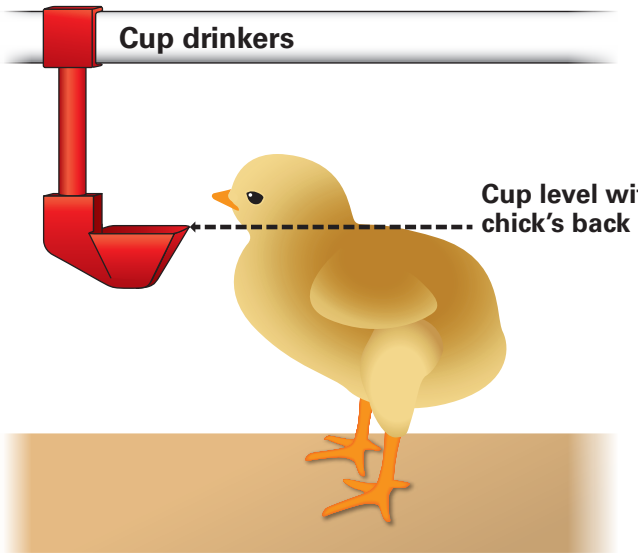
INTERMITTENT LIGHTING PROGRAM

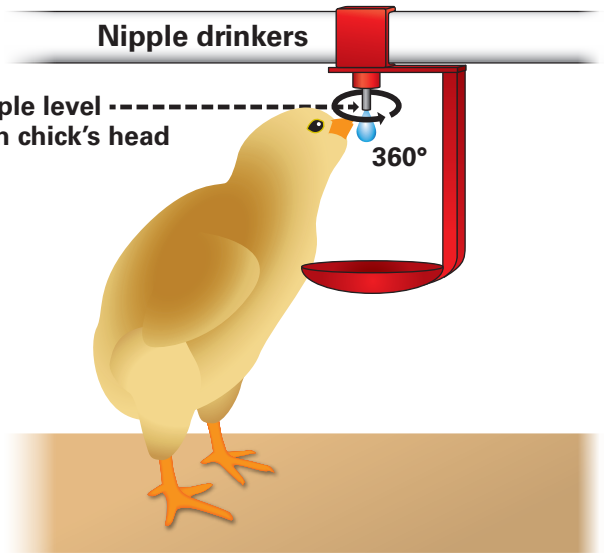


- Optional lighting technique
- Use from 0–7 days
- Intermittent dark periods provide rest periods for chicks
- Synchronizes chicks' activities and feedings
- Establishes more natural behavior of rest and activity
- May improve 7 day livability
- May improve antibody response from vaccinations
- Some dark periods may be shortened or removed to accommodate work schedules

Drinking Systems

- Drinking water should be tested for quality and cleanliness from source and end of water line
- Flush water lines daily during the brooding period, starting day prior to chick arrival. Flush water lines weekly during growing and production periods
- Water temperature should be 10–20°C after flushing
- Nipple drinkers should deliver minimum 70 ml per minute / nipple





- Cup drinkers should be manually filled during 0–3 days to train chicks to drink

- Adjust nipple water system pressure to create hanging drop to help chicks find water for 0–3 days
- Splash cups useful during brooding period and in hot climates
- 360° activated nipples make drinking easy for chicks
- 360° activated nipples essential for hatchery beak-treated chicks

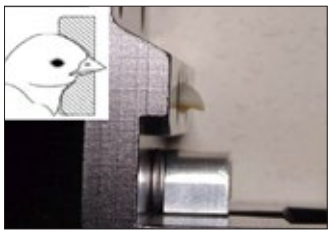
Beak Treatment / Trimming

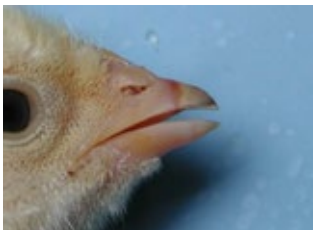
(Check local regulations concerning use of beak trimming)

- Hy-Line Brown commercial layer is most successfully beak trimmed at hatch by infrared beak treatment or between 7–10 days of age
- If necessary, re-trim at 6 weeks or 12–14 weeks of age. Second beak trim is recommended in open-sided housing
- In light-controlled housing, one beak trim should be sufficient
- Beak treatment or beak trimming reduces feed wastage and leaves beak less damaging to other birds

HATCHERY INFRARED BEAK TREATMENT

- Provides efficient, uniform beak treatment
- Beak remains intact until 10–14 days of age when treated portion separates
- Use only 360° activated nipples for beak-treated chicks, as well as supplemental chick drinkers





PRECISION BEAK TRIMMING

- Cauterize beak for 2 seconds
  - When cauterizing blade is not hot enough or cauterization time is <2 seconds, beak will continue to grow unevenly
  - If cauterizing blade is too hot or cauterization time is >2 seconds, sensitive neuromas may form
- Use pyrometer to measure blade temperature which should be approximately 595°C
- Cauterizing blade color may be used as approximate indicator of temperature

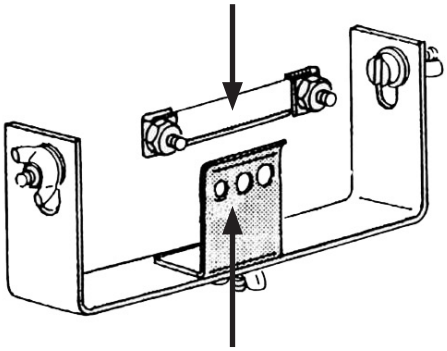
< 595°C **595°C** **> 595°C**

- Blade temperature variation of up to 40°C is common due to external influences and cannot be detected by the human eye
- Use template with guide plate holes for precision beak trim of different size chicks
- Check that beaks have been properly and evenly trimmed

Photo courtesy of Lyon Technologies, Inc.

Properly Trimmed Beaks

Cauterizing blade (595°C, cherry red color)



Template with guide holes

Guide holes correspond to different size and age of chicks

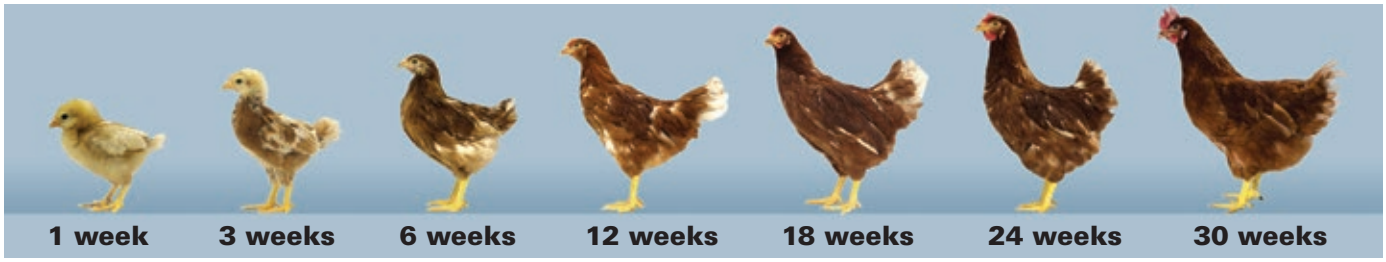
- *4.00 mm*
- *4.37 mm*
- *4.75 mm*

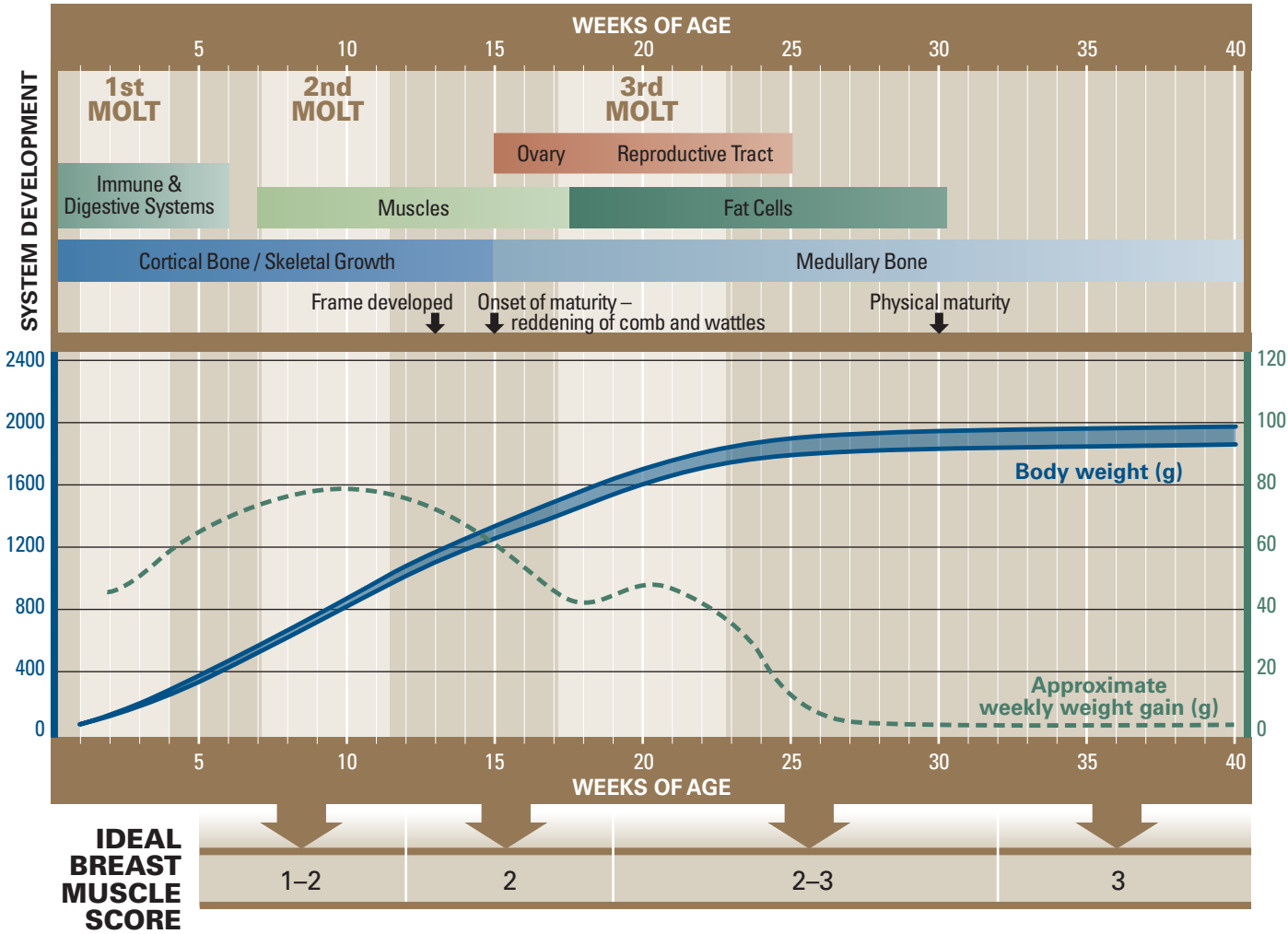
Observe these precautions when beak trimming

- Do not beak-trim sick birds
- Do not hurry
- Provide vitamins and electrolytes containing vitamin K in drinking water 2 days before and 2 days after beak trimming
- Keep feed at highest level for several days after beak trimming
- Use only well-trained crews
- Use 360° activated nipples
- Handle chicks carefully

Layer Growth and Development

- Focus on pullet rearing programs to optimize growth and development
- A pullet flock entering into egg production at correct body weight (1.40–1.48 kg) with uniformity higher than 90% performs best in production period
- Chicks' body weight should double between arrival and 7 days of age
- It is important to achieve 6, 12, 18, 24, and 30 week body weight targets to ensure optimum development of bird's body
- If possible, exceed pullet body weight standards
- Change growing diets only when recommended body weight is attained. Suggested ages are guide if target weights are achieved. See www.hylinepullet.com

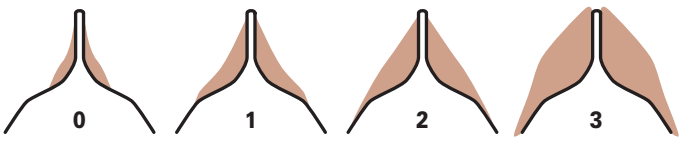




Importance of Muscle Development

- Muscle contains glycogen, source of energy during egg production
- Layers with good muscle development are better able to sustain high egg production

BREAST MUSCLE SCORING



Growing Body Weights, Feed Consumption and Uniformity

AGE (weeks)	BODY WEIGHT (g)	FEED INTAKE (g / bird per day)	UNIFORMITY (Cage)
1	68 – 72	14 – 15	
2	121 – 129	17 – 21	>85%
3	184 – 196	23 – 25	
4	257 – 273	27 – 29	
5	349 – 371	34 – 36	>65%
6	446 – 474	38 – 40	
7	543 – 577	41 – 43	
8	650 – 690	45 – 47	
9	757 – 803	49 – 53	>75%
10	863 – 917	52 – 56	
11	960 – 1020	58 – 62	
12	1048 – 1112	62 – 66	
13	1125 – 1195	67 – 71	
14	1193 – 1267	70 – 74	
15	1261 – 1339	72 – 76	>85%
16	1329 – 1411	75 – 79	
17	1397 – 1483	78 – 82	>90%

Weigh birds separately after 3 weeks using a digital scale that calculates uniformity

3-week old pullets from same flock with very different development shows importance of monitoring flock body weight uniformity

Space Guidelines *(check local regulations)*

WEEKS OF AGE	3	17	20	30	40	50	60	70	80
CONVENTIONAL AND COLONY CAGES									
Floor Space									
100–200 cm^2 (50–100 birds / m^2)	310 cm^2 (32 birds / m^2)		490 cm^2 (20 birds / m^2) – 750 cm^2 (13 birds / m^2)						
Nipple									
1 / 12 birds	1 / 8 birds		1 / 12 birds or access to 2 drinkers						
Feeders									
5 cm / bird	8 cm / bird		7–12 cm / bird						

Requirements vary with type of equipment used and environmental conditions

Cage Systems Management

- Flock can be moved into production facility at 15–16 weeks of age or after administration of last live vaccines
- It is important that growing and production cages contain similar feed and water systems
- Any sex slips should be removed around 7 weeks and at transfer
- Supportive care to reduce stress such as water-soluble vitamins, probiotics and vitamin C should be used 3 days before and 3 days after transfer
- Weigh prior to a scheduled feed change
- Remove mortality daily
- If mortality exceeds 0.1% per week, then perform necropsies and other diagnostics to determine cause(s) of mortality

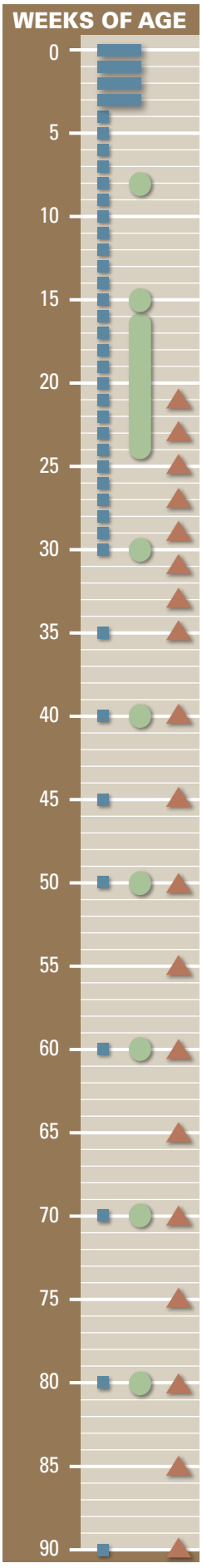
Management Events for Commercial Layers

AGE	CAGE REARING
0	**24–48 hours before chicks arrive** Pre-heat brooding house
1 day	
2 days	
3 days	
4 days	
5 days	
6 days	
1 week	**7–10 days** Precision beak trimming if not done in hatchery; check local regulations
8 days	
9 days	
10 days	
11 days	
12 days	
13 days	
2 weeks	**2 weeks** Cage paper removed by this time
15 days	
16 days	
17 days	
18 days	
19 days	
20 days	
3 weeks	
4 weeks	
5 weeks	
6 weeks	
7 weeks	**7–13 weeks** Remove sex-slips (off-sex) during vaccination handling
8 weeks	
9 weeks	
10 weeks	
11 weeks	
12 weeks	
13 weeks	
14 weeks	
15 weeks	**15–16 weeks** Transfer to lay house early to allow birds to become familiar with new environment
16 weeks	
17 weeks	**17 weeks** Light stimulation when pullets reach 1.40–1.48 kg body weight
18 weeks	
19 weeks	
20 weeks	
21 weeks	**21 weeks** Monitor egg weights every 2 weeks. Start controlling egg weight when average egg weight is within 2 g of target

Bird Handling—BE GENTLE

- *Proper handling of birds during body weight measurements, blood collection, selection, vaccination, and transfer will reduce bird stress and prevent injuries*
- *Hold birds by both legs or both wings*
- *Return birds to cage gently*
- *Use experienced personnel that have been trained in proper procedures of bird handling*

Management Events for Commercial Layers



AGES OF BODY WEIGHT MEASUREMENTS

- Weigh separate groups of birds on each cage level due to temperature and environmental differences
- Identify cages from beginning and end of feed lines
- Mark cages and use same cage every time body weight is monitored

0–3 weeks

- Bulk weigh 10 boxes of 10 chicks

4–29 weeks

- Weigh 100 birds individually every week
- Weigh birds in same cages each time for best accuracy
- Calculate uniformity

30–50 weeks

- Weigh 100 birds individually every 5 weeks
- Weigh birds in same cages each time for best accuracy
- Calculate uniformity

Over 50 weeks

- Weigh 100 birds individually every 10 weeks
- Weigh birds in same cages each time for best accuracy
- Calculate uniformity

When handling birds for body weights assess:

- Keel bone—straightness and firmness
- Breast muscle score
- Body fat
- External parasites
- Clinical symptoms of disease

CALCULATING UNIFORMITY

- Use individual bird weights
- Uniformity calculation tool available at www.hylinebodyweight.com

AGES OF BLOOD COLLECTION

10–20 sera samples per flock for titer determination

8 weeks

- Assess early vaccination technique and disease exposure

15 weeks

- Blood collection before transfer to lay house to assess possible change in disease exposure
- Common to not send to laboratory and freeze for future analysis in event of disease outbreak on lay farm

16–24 weeks

- Collect blood at least 4 weeks after final inactivated vaccination
- Useful to assess disease challenge after transfer to lay farm

AGES TO MONITOR EGG WEIGHTS

Weigh 100 eggs collected from egg belts in front of randomly selected cages (may be same cages used for body weight monitoring) to ensure even distribution of egg samples. Monitor egg weights on specific day of week within same 3 hour time frame

Good Lighting Practices

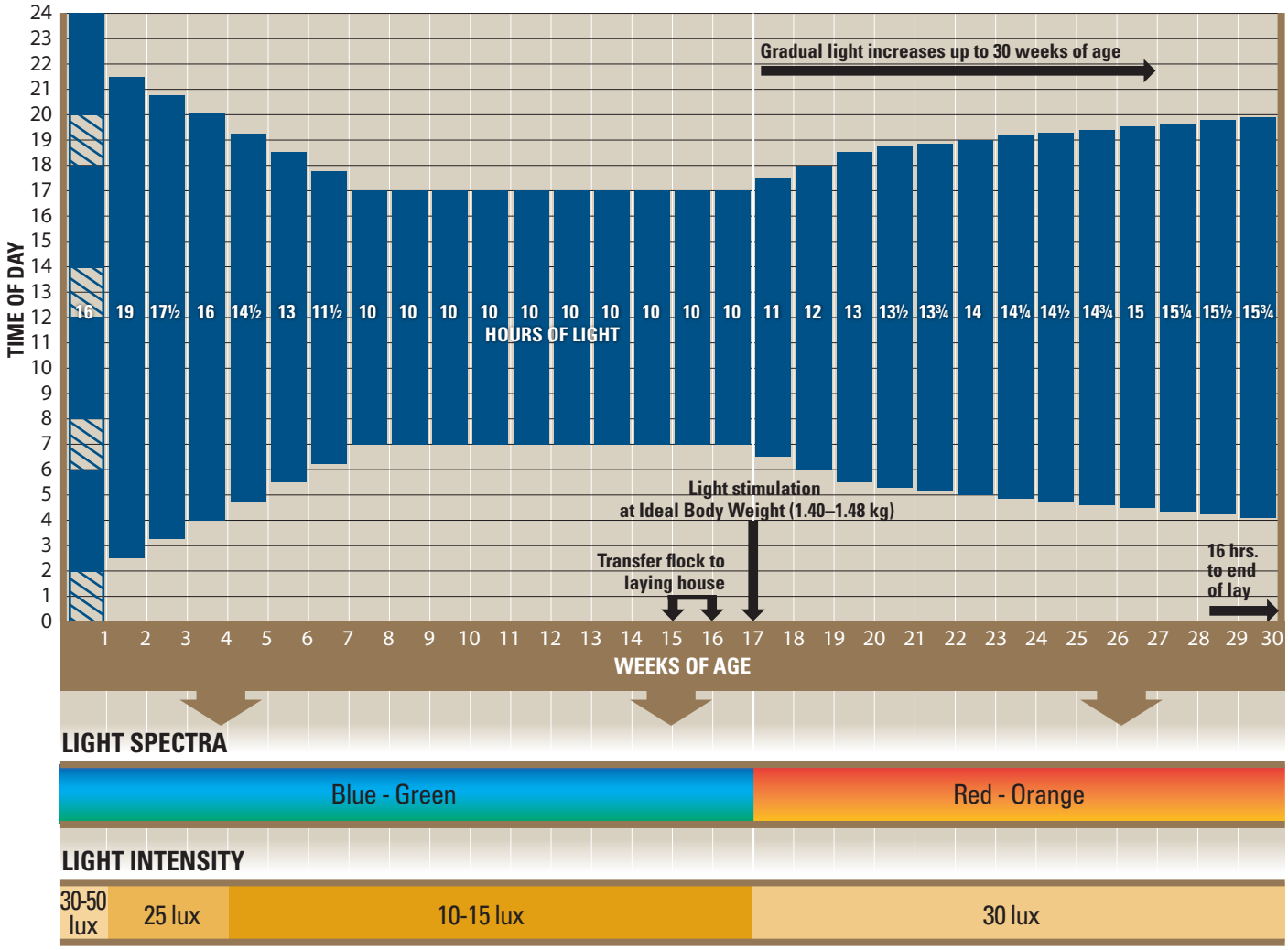
- In cage housing, measure minimum light intensity at feeder on bottom tier cages, mid-way between lights
- Keep light bulbs clean to prevent loss of light intensity
- Prevent dark areas caused by too much distance between lights or burned out light bulbs
- Be aware that shiny or white surfaces reflect light and increase light intensity
- Take local conditions into account which may require adaptations of lighting programs
- Light hours of growing and production houses should be matched at transfer
- Light stimulation period should extend into peaking period (achieve 16 hours of light at about 30 weeks)
- Light intensity should increase weekly for 2 weeks before flock is transferred to laying house

Light Program for Light-Controlled Housing

(www.hylineweblighting.com)

Slow step-down of light hours from 0–8 weeks to encourage

- Feed intake during grow to optimize growth and development
- Good uniformity in hens
- Persistency of egg production
- Production of larger eggs

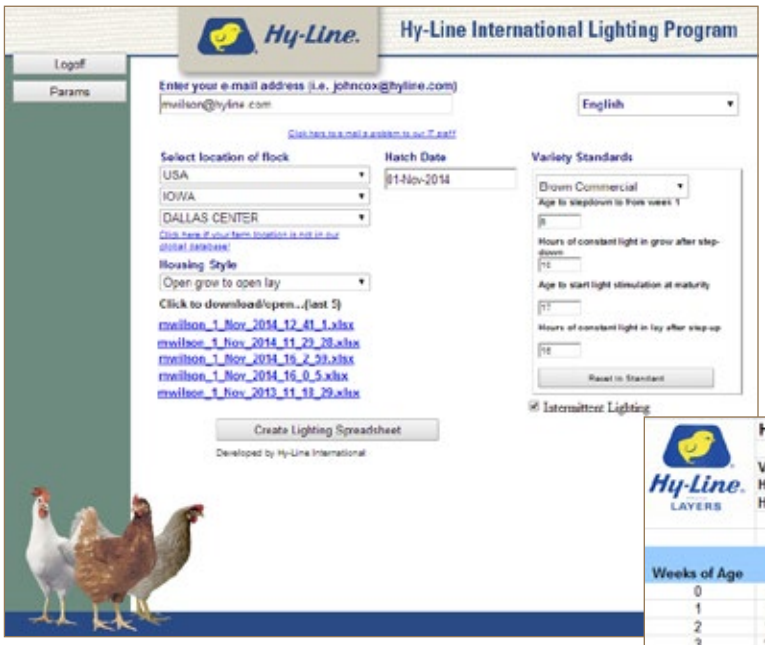


Alternate Program

Slower step-down of light hours from 0–12 weeks can be used to prevent early sexual maturity, maximize pullet growth and promote early egg size

Customized Lighting Programs for Open-Sided Housing *(www.hylineweblighting.com)*

To prevent early sexual development, the Hy-Line International Lighting program finds the longest natural day length between 8–17 weeks of age and constructs an artificial lighting program that holds day length constant with artificial lights from 8–17 weeks.



- *Enter your e-mail address*
- *Enter variety/generation, location, housing style and hatch date*
- *Select language*
- *Click on "Create Lighting Spreadsheet"*
- *Results will appear*
- *Click on "download Excel" to access graphical forms, print and save results*

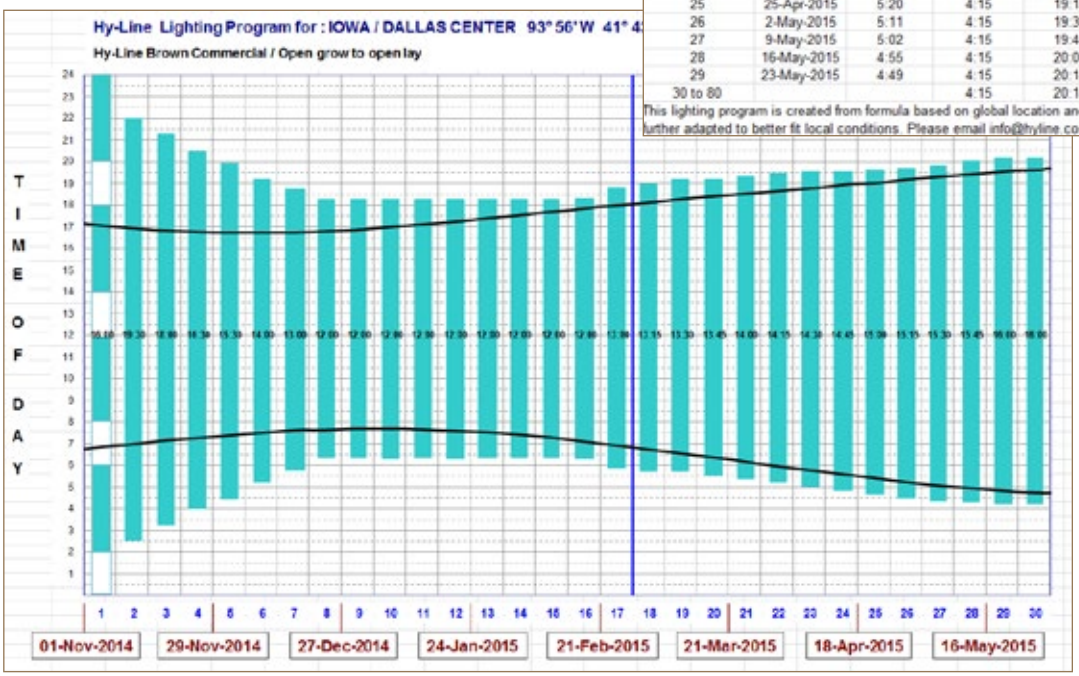
Hy-Line Lighting Program for : IOWA / DALLAS CENTER 93° 56' W 41° 43' N

Variety: Brown Commercial
House Type: Open grow to open lay
Hatch Date: 01-Nov-2014 Standard daylight time

Weeks of Age	Date	Sunrise	Lights on	Lights Off	Sunset	Total Hours	Total Sunlight
0	1-Nov-2014		INTERMITTENT LIGHTING			16:00	
1	8-Nov-2014	6:56	2:45	22:15	17:02	19:30	10:06
2	15-Nov-2014	7:04	3:30	21:30	16:55	18:00	9:51
3	22-Nov-2014	7:13	4:15	20:45	16:50	16:30	9:37
4	29-Nov-2014	7:21	4:45	20:15	16:46	15:30	9:25
5	6-Dec-2014	7:28	5:15	19:15	16:45	14:00	9:17
6	13-Dec-2014	7:34	5:45	18:45	16:45	13:00	9:11
7	20-Dec-2014	7:38	6:15	18:30	16:47	12:00	9:09
8	27-Dec-2014	7:41	6:15	18:30	16:51	12:00	9:10
9	3-Jan-2015	7:43	6:15	18:30	16:57	12:00	9:14
10	10-Jan-2015	7:42	6:15	18:30	17:04	12:00	9:22
11	17-Jan-2015	7:39	6:15	18:30	17:12	12:00	9:33
12	24-Jan-2015	7:35	6:15	18:30	17:20	12:00	9:45
13	31-Jan-2015	7:29	6:15	18:30	17:29	12:00	10:00
14	7-Feb-2015	7:21	6:15	18:30	17:38	12:00	10:17
15	14-Feb-2015	7:12	6:15	18:30	17:47	12:00	10:35
16	21-Feb-2015	7:03	6:15	18:30	17:56	12:00	10:53
17	28-Feb-2015	6:52	5:45	19:00	18:04	13:00	11:12
18	7-Mar-2015	6:41	5:15	19:00	18:12	13:15	11:31
19	14-Mar-2015	6:29	5:00	19:00	18:20	13:30	11:51
20	21-Mar-2015	6:17	4:45	19:00	18:28	13:45	12:11
21	28-Mar-2015	6:05	4:30	19:00	18:36	14:00	12:31
22	4-Apr-2015	5:53	4:30	19:00	18:44	14:15	12:51
23	11-Apr-2015	5:42	4:15	19:00	18:51	14:30	13:09
24	18-Apr-2015	5:31	4:15	19:00	18:59	14:45	13:28
25	25-Apr-2015	5:20	4:15	19:15	19:07	15:00	13:47
26	2-May-2015	5:11	4:15	19:30	19:14	15:15	14:03
27	9-May-2015	5:02	4:15	19:45	19:22	15:30	14:20
28	16-May-2015	4:55	4:15	20:00	19:29	15:45	14:34
29	23-May-2015	4:49	4:15	20:15	19:36	16:00	14:47
30 to 80			4:15	20:15		16:00	

This lighting program is created from formula based on global location and housing style. This program may need to be further adapted to better fit local conditions. Please email info@hyline.com for further questions or technical assistance.

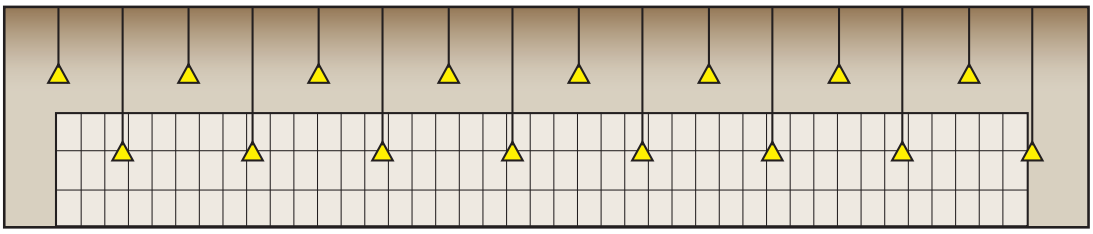
Same lighting program with sunrise and sunset represented by black lines and suggested artificial day length indicated by blue bars



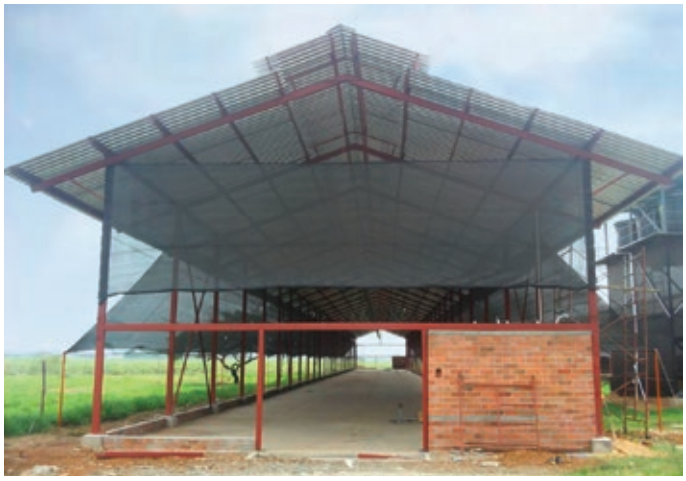
Lighting Considerations

CAGES

- Alternating height of lights improves light distribution to all cage levels



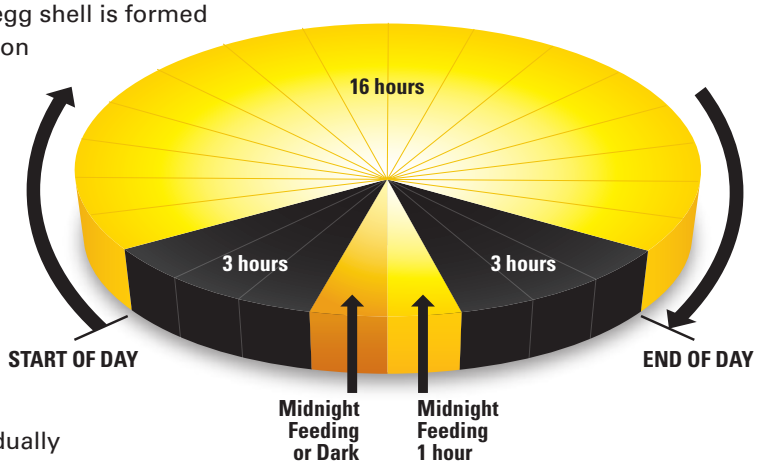
Use of Shades in Open-Sided Housing



- Shades are an effective way to decrease light intensity in an open-sided house
- Keep shades clean and free of dust to allow air flow
- Use stir fans when using shades
- Avoid direct sunlight on birds by using shades or roof overhangs
- Black shades are preferred

Midnight Feeding / Lighting Program

- Optional lighting technique that promotes greater feed consumption
- Used whenever more feed intake is desired in growing or laying flocks
- Increases calcium absorption during night when most egg shell is formed
- Useful to increase feed intake during peak egg production
- Helps maintain feed consumption in hot climates
- Midnight feeding may increase feed intake 2–5 g / day per bird



Good Practices

- Initiate program by turning lights on for 1–2 hours in middle of dark period
- Fill feeders before lights turned on
- Must be at least 3 hours of dark before and after midnight feeding
- Light provided during midnight feeding is in addition to regular day length (i.e. 16 hours)
- If midnight feeding is removed, it must be reduced gradually at rate of 15 minutes per week

Water Quality

- Water is the most important nutrient. Good quality water must be available to birds at all times
- Water and feed consumption are directly related—when birds drink less, they consume less feed and production quickly declines
- As a general rule, healthy birds will consume 1.5–2.0 times more water than feed. This ratio increases in high ambient temperatures
- High concentrations of sodium or other minerals may require changes in ration formulation
- Test water quality at least 1 time per year. Water source will determine regularity of water testing
  - Surface water requires more frequent testing, as it is more affected by season and rainfall patterns
  - Closed wells taking water from aquifers or deep artesian basins will be more consistent in water quality, but are generally higher in dissolved mineral content
- Presence of coliform bacteria is good indicator if water source has been contaminated with animal or human waste
- When collecting well water sample, let water run for 2 minutes prior to collecting sample. Water samples should be kept below 10°C and submitted to lab in less than 24 hours
- Some water sources contain high levels of dissolved minerals such as calcium, sodium and magnesium. When this occurs, amounts of these minerals in water has to be considered when formulating feed
- Ideal water pH is 5–7 to promote good water sanitation, increase feed consumption and improve upper gastrointestinal health
- Less than optimum water quality can have significant impact on gut health which will lead to under utilization of nutrients in feed

ITEM	MAXIMUM CONCENTRATION (ppm or mg/L)*	
Nitrate NO_3^- [1]	25	Older birds will tolerate higher levels up to 20 ppm. Stressed or diseased challenged birds may be more sensitive to effects of Nitrate
Nitrate Nitrogen (NO_3-N) [1]	6	
Nitrite NO_2^- [1]	4	Nitrite is considerably more toxic than Nitrate, especially for young birds where 1 ppm Nitrite may be considered toxic
Nitrite Nitrogen (NO_2-N) [1]	1	
Total dissolved solids [2]	1000	Levels up to 3000 ppm may not affect performance but could increase dropping moisture
Chloride (Cl^-) [1]	250	Levels as low as 14 mg may be problematic if sodium higher than 50 ppm
Sulfate (SO_4^-) [1]	250	Higher levels may be laxative
Iron (Fe) [1]	<0.3	Higher levels will cause bad odor and taste
Magnesium (Mg) [1]	125	Higher levels may be laxative. Levels above 50 ppm may be problematic if sulphate levels are high
Potassium (K) [2]	20	Higher levels may be acceptable depending on sodium level, alkalinity and pH
Sodium (Na) [1,2]	50	Higher concentration acceptable but concentrations above 50 ppm should be avoided if high levels of chloride, sulphate or potassium
Manganese (Mn) [3]	0.05	Higher levels may be laxative
Arsenic (As) [2]	0.5	
Fluoride (F^-) [2]	2	
Aluminum (Al) [2]	5	
Boron (B) [2]	5	
Cadmium (Cd) [2]	0.02	
Cobalt (Co) [2]	1	
Copper (Cu) [1]	0.6	Higher levels result in bitter taste
Lead (Pb) [1]	0.02	Higher levels are toxic
Mercury (Hg) [2]	0.003	Higher levels are toxic
Zinc (Zn) [1]	1.5	Higher levels are toxic
pH [1]	6.3–7.5	Birds may adapt to lower pH. Below pH 5 may reduce water intake and corrode metal fittings. Above pH 8 may reduce intake and reduce effectiveness of water sanitation
Total bacteria counts [3]	1000 CFU/ml	Likely to indicate dirty water
Total Coliform bacteria [3]	50 CFU/ml	
Fecal Coliform bacteria [3]	0 CFU/ml	
Oxygen Reduction Potential (ORP) [3]	650–750 mEq	ORP range that 2–4 ppm of free choline will effectively sanitize water at favorable pH range of 5–7

*Limits may be lower as interactions exist between magnesium and sulphate; and between sodium, potassium, chloride and sulphate

[1] Carter & Sneed, 1996. Drinking Water Quality for Poultry, Poultry Science and Technology Guide, North Carolina State University Poultry Extension Service. Guide no. 42

[2] Marx and Jaikaran, 2007. Water Analysis Interpretation. Agri-Facts, Alberta Ag-Info Centre. Refer to http://www.agric.gov.ab.ca/app84/rwqit for online Water Analysis Tool

[3] Watkins, 2008. Water: Identifying and correcting challenges. Water: Identifying and Correcting Challenges. Avian Advice 10(3): 10-15 University of Arkansas Cooperative Extension Service, Fayetteville

Water Consumption

Water Consumed / 100 Birds per Day

AGE IN WEEKS	LITERS
1–3	1–3
4–6	3–6
7–9	6–8
10–12	8–12
13–15	10–14
16–18	11–18
19–22	13–21
23+	15–23

Chart shows an expected range of water consumption at normal environmental temperatures of 21–27°C. As environmental temperature increases above this range, water consumption may increase up to double amounts shown

Air Quality

Air Movement (m^3 / hour per 1000 birds)

AMBIENT TEMPERATURE (°C)	WEEKS OF AGE					
	1	3	6	12	18	19+
32	360	540	1250	3000	7140	9340–12000
21	180	270	630	1500	3050	5100–6800
10	130	180	420	800	2240	3060–4250
0	75	136	289	540	1500	1020–1700
-12	75	110	210	400	600	700–1050
-23	75	110	210	400	600	700–850

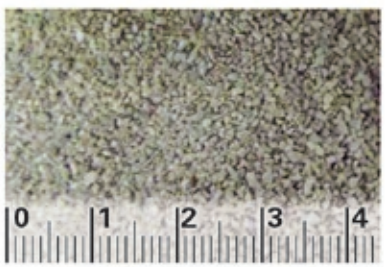
Acknowledgment: Dr. Hongwei Xin, Professor, Department of Agriculture and Biosystems Engineering and Department of Animal Science, Iowa State University, Ames, Iowa, USA

- Production house should be 18–25°C and 40–60% humidity
- General rule for determining required fan capacity—4 m^3 of air movement / kilogram of body weight per hour
- Ventilation is essential to
  - Provide each bird with adequate supply of oxygen
  - Remove moisture from house
  - Remove carbon dioxide produced by birds
  - Remove dust particles
  - Dilute aerosolized pathogenic organisms

Calcium Particle Size

PARTICLE SIZE	STARTER, GROWER, DEVELOPER	PRE-LAY	PEAKING First egg to peak	LAYER 2 90–84%	LAYER 3 83–77%	LAYER 4 Less than 77%
Fine (0–2 mm)	100%	50%	50%	40%	35%	35%
Coarse (2–4 mm)	–	50%	50%	60%	65%	65%

Appropriate particle size depends on solubility of limestone. Dietary calcium levels may need to be adjusted based on limestone solubility



Fine calcium (0–2 mm)

Coarse calcium (2–4 mm)

Photos courtesy of Longcliff Quarries Ltd.

Feed Particle Size

Sieve shaker separates feed sample into categories based on particle size

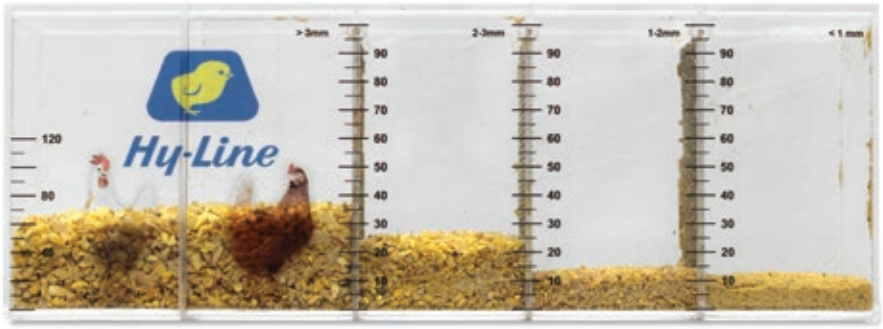
- Used on farm to check feed particle size from feed mill—sample taken on delivery or from feed bins
- Assess uniformity of feed particle size throughout feeding system—samples taken from various points

Too many fine feed particles

- Decrease feed intake and nutrient absorption
- Increase dust in house

Too many coarse feed particles

- Birds selectively eat large particles
- Increase risk of feed separation



Hy-Line Sieve Shaker

OPTIMAL FEED PARTICLE PROFILE

PARTICLE SIZE	STARTER	GROWER	DEVELOPER	PRODUCTION
0–1 mm	–	25%	25%	25%
1–2 mm	Crumble	65%	35%	35%
2–3 mm	–	10%	35%	35%
3–4 mm	–	–	5%	5%

Best Practices

- 3–4 hour gap in mid-day feedings allows birds to consume fine particles
- Add minimum of 0.5% liquid oil/fat in meal diets to incorporate and retain small particles in feed
- Use larger particle size meal or crumble to increase intakes in hot climates

Vitamins and Trace Minerals

- As the vitamin / trace mineral premix is often found in fine feed particles, a minimum level of 0.5% added liquid oil / fat in meal diets binds small particles in feed
- Manage feeders to allow birds to consume fine particles during mid-day

VITAMINS

ITEM [1,2,3,4]	IN 1000 KG COMPLETE DIET
Vitamin A, IU	12,000,000
Vitamin D_3[5], IU	4,400,000
Vitamin E, g	75
Vitamin K (menadione), g	4
Thiamin (B_1), g	3
Riboflavin (B_2), g	12
Niacin (B_3), g	55
Pantothenic acid (B_5), g	18
Pyridoxine (B_6), g	5.5
Biotin (B_7), mg	300
Folic acid (B_9), g	2.5
Cobalamine (B_{12}), mg	30
Choline[7], g	250

MINERALS

ITEM [1]	IN 1000 KG COMPLETE DIET
Manganese[6], g	100
Zinc[6], g	100
Iron, g	65
Copper[6], g	20
Iodine, g	2.5
Selenium[6], g	0.3

[1] Minimum recommendations for growing and laying periods. Higher levels of vitamins may be beneficial at start of lay, during stress periods and hot weather. Local regulations may limit dietary content of individual vitamins or minerals

[2] Store premixes according to suppliers' recommendations and observe "use by" dates to ensure vitamin activity is maintained. Inclusion of antioxidant may improve premix stability

[3] Vitamin and mineral recommendations are according to activity

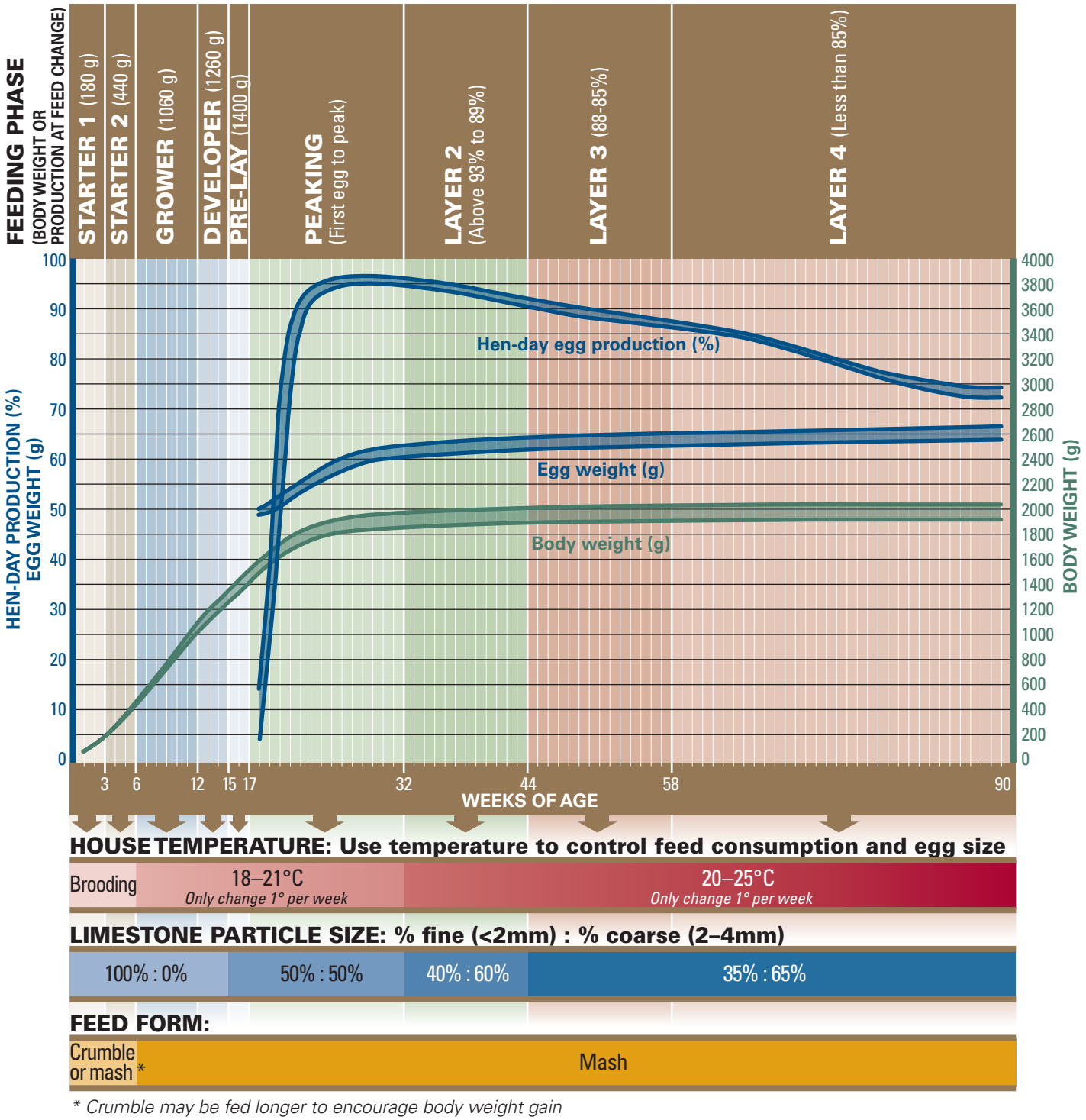
[4] Where heat treatment is applied to diet, higher levels of vitamins may be required. Consult with vitamin supplier regarding stability through feed production processes

[5] A proportion of Vitamin D_3 may be supplemented as 25-hydroxy D_3 according to suppliers recommendations and applicable limits

[6] Use of chelated minerals may be beneficial to performance

[7] Supplementation rates may require adjustment when other dietary sources are considered

Phase Feeding to Meet the Hen's Nutritional Needs



** Crumble may be fed longer to encourage body weight gain*

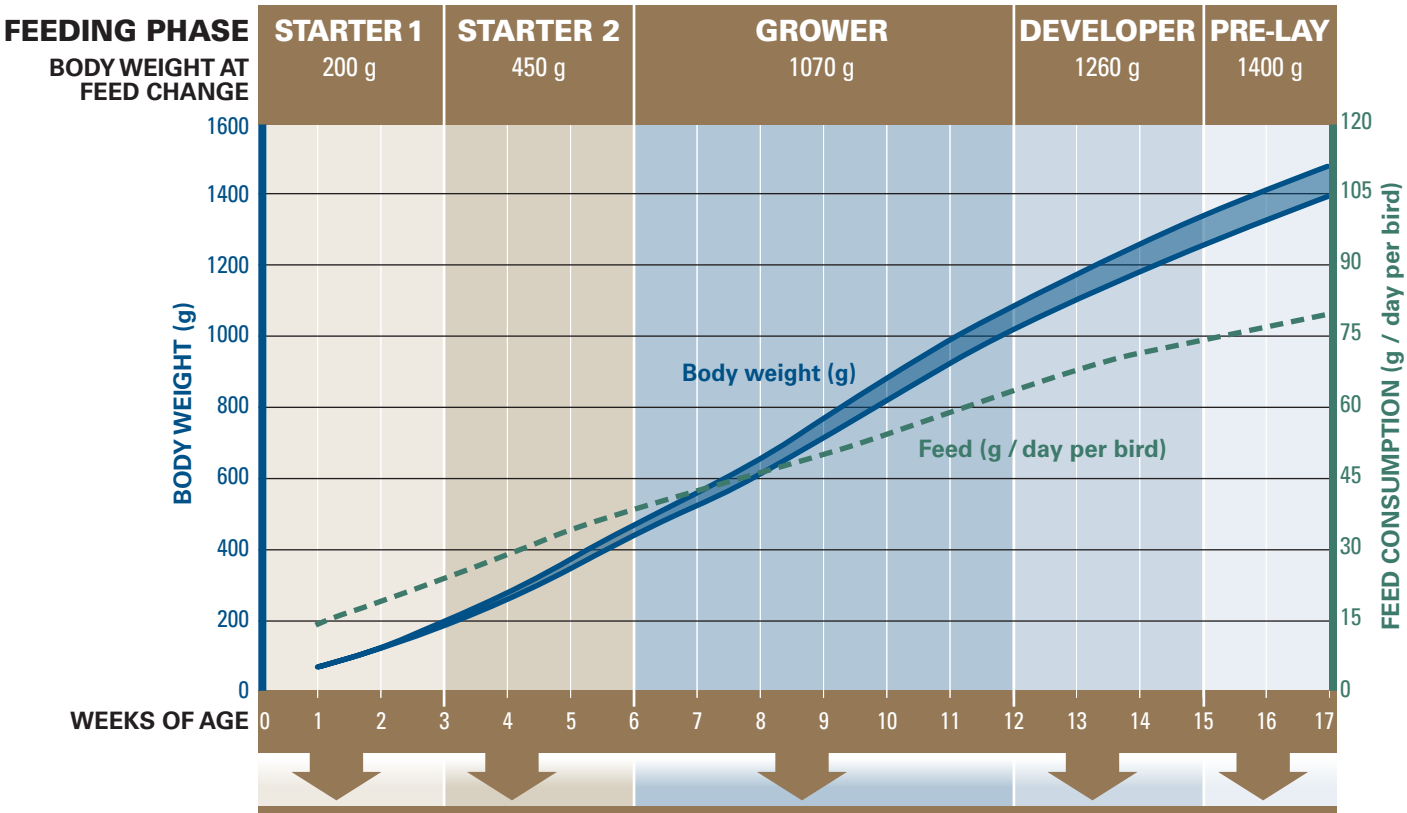
Controlling Egg Weight

- Closely monitor egg weight of each flock and make nutritional changes as needed to ensure optimal egg weight
- If smaller eggs are desired, egg weight should be controlled even more aggressively at an early age
- Egg-weight control is achieved through combination of limiting amino acid consumption and ensuring that feed intake is not too high (achieved through control of ambient temperature)
- Monitor egg weight every 2 weeks. Start controlling egg weight when average egg weight is within 2 g of target

Control of Ambient House Temperature

- At housing, an ambient temperature of 18-20°C is desired. Increase house temperature about 1°C every 2 weeks until reaching 25°C assuming ventilation systems able to maintain adequate air quality at these temperatures
- Lower (colder) house temperatures will lead to greater feed intakes and may be counterproductive to egg-weight control, as well as optimal feed efficiency and adult hen body weights

Growing Period Nutritional Recommendations



NUTRITION	STARTER 1	STARTER 2	GROWER	DEVELOPER	PRE-LAY
	RECOMMENDED CONCENTRATION[1]				
Metabolizable energy[2], kcal/kg	2867–3043	2867–3043	2844–3021	2844–3021	2822–2999
Metabolizable energy[2], MJ/kg	12–12.74	12–12.74	11.91–12.64	11.91–12.64	11.81–12.55
	RECOMMENDED DAILY INTAKE				
	Standardized Ileal Digestible Amino Acids / Total Amino Acids[3]				
Lysine, %	**1.01** / 1.11	**0.92** / 1.01	**0.82** / 0.90	**0.67** / 0.73	**0.72** / 0.79
Methionine, %	**0.45** / 0.49	**0.42** / 0.46	**0.39** / 0.41	**0.31** / 0.34	**0.35** / 0.38
Methionine+cystine, %	**0.77** / 0.87	**0.72** / 0.81	**0.66** / 0.75	**0.56** / 0.63	**0.62** / 0.70
Threonine, %	**0.65** / 0.76	**0.60** / 0.70	**0.55** / 0.65	**0.46** / 0.54	**0.50** / 0.58
Tryptophan, %	**0.18** / 0.22	**0.17** / 0.21	**0.17** / 0.21	**0.15** / 0.18	**0.16** / 0.19
Arginine, %	**1.05** / 1.13	**0.96** / 1.03	**0.85** / 0.92	**0.70** / 0.75	**0.75** / 0.81
Isoleucine, %	**0.71** / 0.76	**0.66** / 0.71	**0.61** / 0.65	**0.50** / 0.54	**0.56** / 0.60
Valine, %	**0.73** / 0.80	**0.68** / 0.75	**0.64** / 0.71	**0.54** / 0.59	**0.61** / 0.68
Crude protein[4], %	20.00	18.25	17.50	16.00	16.50
Calcium[5], %	1.00	1.00	1.00	1.40	2.50
Phosphorus (available)[6], %	0.45	0.44	0.43	0.45	0.48
Sodium, %	0.18	0.17	0.17	0.18	0.18
Chloride, %	0.18	0.17	0.17	0.18	0.18
Linoleic acid (C18:2 n-6), %	1.00	1.00	1.00	1.00	1.00

[1] Change diets at recommended target body weight—approximate age is a guide only. Do not feed Pre-Lay later than first egg as it contains insufficient calcium to support egg production

[2] Recommended energy range is based on raw material energy values shown in table at back of this guide. It is important that target concentrations of dietary energy are adjusted according to energy system applied to raw material matrix

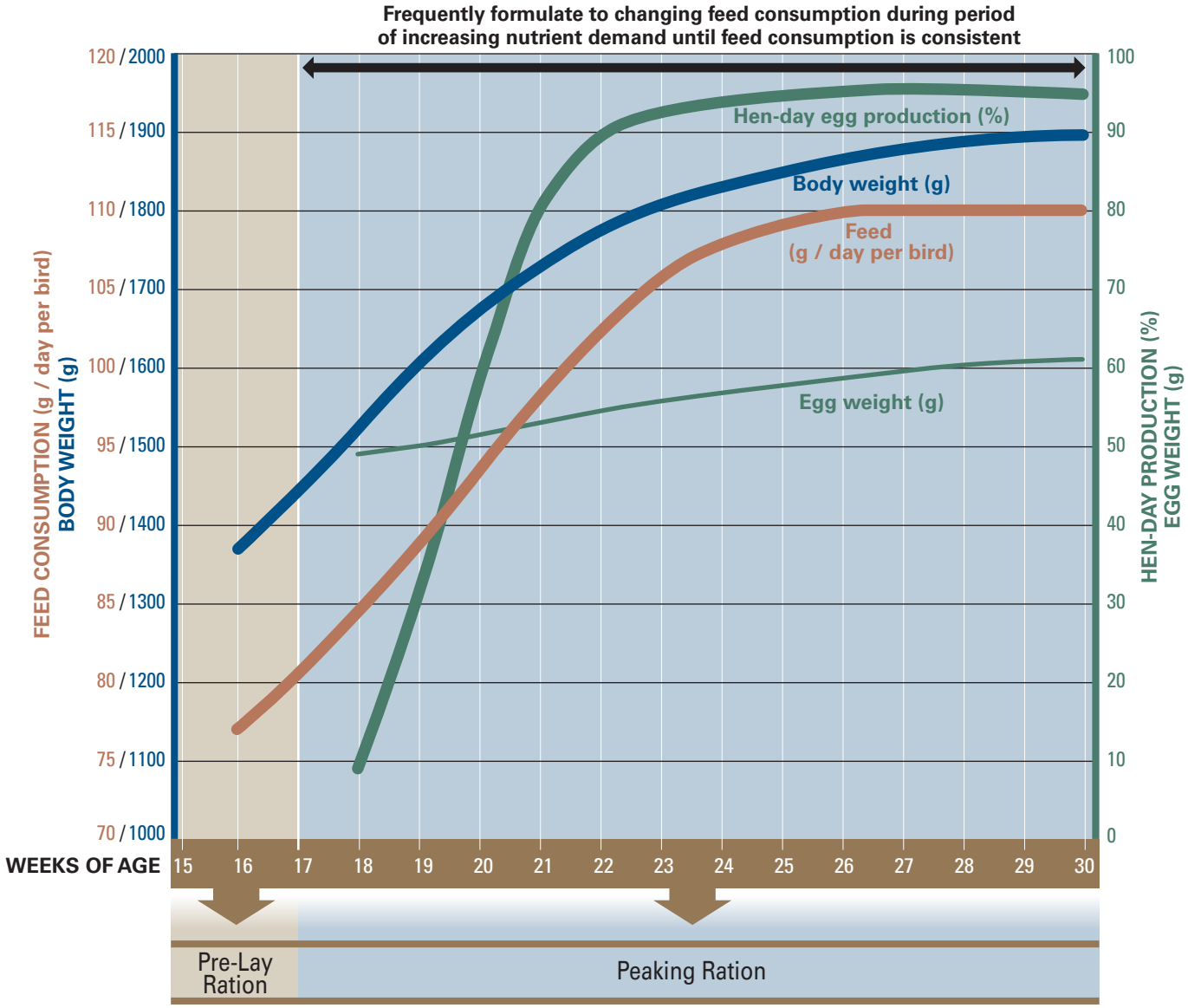
[3] Recommendation for Total Amino Acids is only appropriate to corn and soybean meal diet. Where diets utilize other ingredients, recommendations for Standardized Ileal Digestible Amino Acids must be followed

[4] Diets should always be formulated to provide required intake of amino acid. Concentration of Crude Protein in diet will vary with raw material used. Crude Protein value provided is an estimated typical value only

[5] Calcium should be supplied as fine calcium carbonate (mean particle size less than 2 mm). Coarse limestone (2–4 mm) can be introduced in Pre-Lay Diet at up to 50% of total limestone

[6] Where other phosphorus systems are used, diets should contain recommended minimum level of available phosphorus

Transition Period from Grow to Peak Egg Production



- During transition period, nutrient requirements increase dramatically
- Occurring during transition
  - Rapidly increasing egg production
  - Increasing egg size
  - Increasing body weight
- Feed consumption may increase slowly during transition
  - In underweight birds
  - In flocks lacking uniformity
  - During high environmental temperatures
- Poor uniformity prolongs transition period and may result in low peak and poor persistency of production
- Monitor feed intake carefully during transition and adjust dietary nutrient concentration accordingly

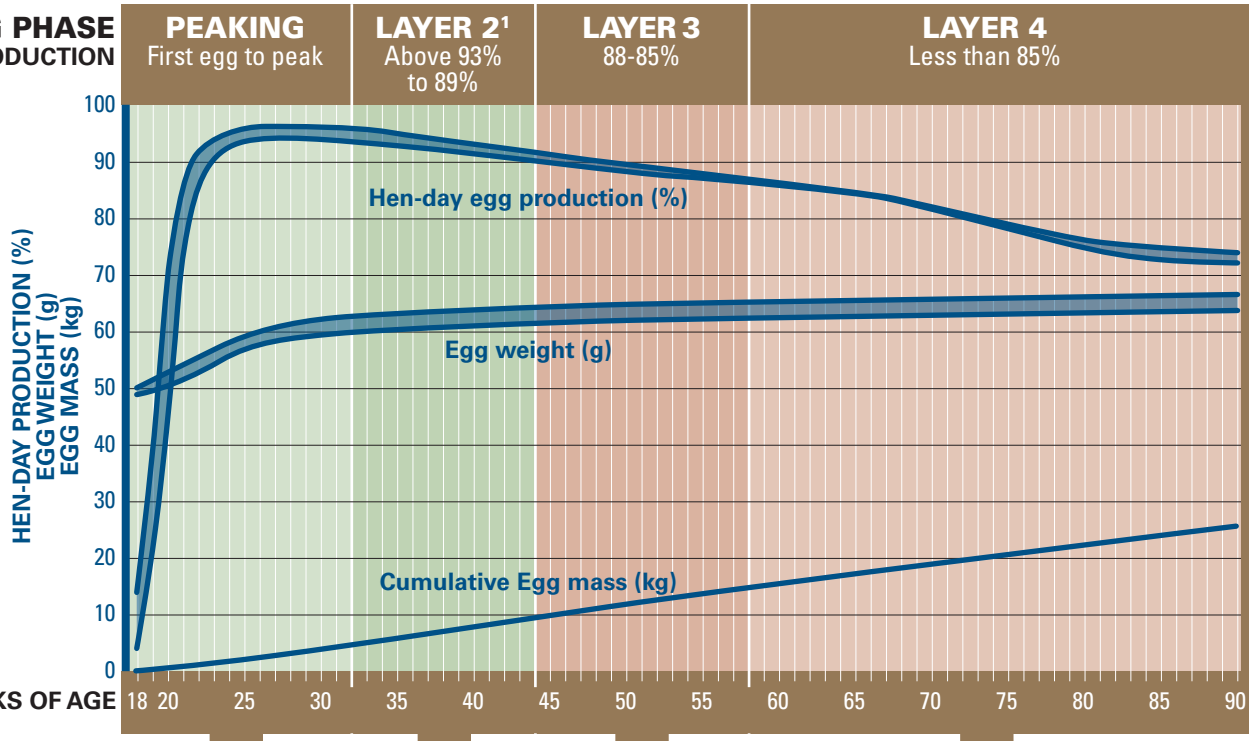
Pre-Lay Ration

- Fed when most pullets show reddening of combs
- Important to increase medullary bone reserves
- Plan to feed for maximum of 10–14 days before point of lay. See www.hylineskeleton.com

Peaking Ration

- Formulations for low feed intakes (88–95 g / day per bird) may be given to better meet nutrient requirements
- Begin Peaking Diet with onset of lay (1% egg production)
- Feed intake may be reduced if birds are not accustomed to extra large particle calcium (i.e. use of a Pre-Lay Diet)

Production Period Nutritional Recommendations



NUTRITION	RECOMMENDED CONCENTRATION[1,2]			
Metabolizable energy[3], kcal/kg	2778–2911	2734–2867	2679–2867	2558–2833
Metabolizable energy[3], MJ/kg	11.63–12.18	11.44–12.00	11.21–12.00	10.71–11.86
	RECOMMENDED DAILY INTAKE			
	Standardized Ileal Digestible Amino Acids / Total Amino Acids[4]			
Lysine, mg/day	**830** / 909	**800** / 876	**780** / 854	**750** / 821
Methionine, mg/day	**407** / 437	**392** / 422	**382** / 411	**360** / 387
Methionine+cystine, mg/day	**714** / 805	**688** / 776	**663** / 748	**630** / 711
Threonine, mg/day	**581** / 684	**560** / 659	**546** / 642	**525** / 618
Tryptophan, mg/day	**174** / 208	**168** / 201	**164** / 196	**158** / 188
Arginine, mg/day	**863** / 928	**832** / 895	**811** / 872	**780** / 839
Isoleucine, mg/day	**647** / 696	**624** / 671	**608** / 654	**585** / 629
Valine, mg/day	**730** / 806	**704** / 776	**686** / 757	**660** / 728
Crude protein[5], g/day	17.00	16.75	16.00	15.50
Calcium[6,8], g/day	4.20	4.30	4.50	4.60
Phosphorus (available)[7,8], mg/day	460	420	380	370
Sodium, mg/day	180	180	180	180
Chloride, mg/day	180	180	180	180
Linoleic acid (C18:2 n-6), g/day	1.00	1.00	1.00	1.00
Choline, mg/day	100	100	100	100

[1] Change to Layer 2 Diet when egg production has decreased 2% from peak egg production

[2] Crude protein, methionine+cystine, fat, linoleic acid, and / or energy may be changed to optimize egg size

[3] Recommended energy range is based on energy values shown in table at back of this guide. It is important that target concentrations of dietary energy are adjusted according to energy system applied to raw material matrix if values differ from those referred for raw materials in this guide

[4] Recommendation for Total Amino Acids is only appropriate to corn and soybean meal diet. Where diets utilize other ingredients, recommendations for Standardized Ileal Digestible Amino Acids must be followed

[5] Diets should always be formulated to provide required intake of amino acid. Concentration of Crude Protein in diet will vary with raw material used. Crude Protein value provided is an estimated typical value only

[6] Calcium carbonate particle size varies throughout lay. Refer to Calcium Particle Size Table (dietary calcium levels may need to be adjusted based on limestone solubility)

[7] Where other phosphorus systems are used, diets should contain recommended minimum level of available phosphorus

[8] For laying cycles beyond 75 weeks increase calcium to 4.8 grams / day and reduce available phosphorous to 360 mg / day

Dietary Nutrient Concentrations for Production Period *(According to Phase and Feed Intake)*

FEEDING PHASE / PRODUCTION	PEAKING First egg to peak						LAYER 2[1] Above 93 to 89%					LAYER 3 88–85%					LAYER 4 Less than 85%				
NUTRITION	**RECOMMENDED CONCENTRATION[1,2]**																				
Metabolizable energy[3], kcal/kg	2778-2911						2734–2867					2679–2867					2558–2833				
Metabolizable energy[3], MJ/kg	11.63–12.18						11.44–12.00					11.21–12.00					10.71–11.86				
	FEED CONSUMPTION (*Typical Feed Consumption)																				
g/day per bird	88	93	98	**103***	108	113	100	105	**110***	115	120	100	105	**110***	115	120	99	104	**109**	114	119
	Standardized Ileal Digestible Amino Acids																				
Lysine, %	0.94	0.89	0.85	**0.81**	0.77	0.73	0.80	0.76	**0.73**	0.70	0.67	0.78	0.74	**0.71**	0.68	0.65	0.76	0.72	**0.69**	0.66	0.63
Methionine, %	0.46	0.44	0.42	**0.40**	0.38	0.36	0.39	0.37	**0.36**	0.34	0.33	0.38	0.36	**0.35**	0.33	0.32	0.36	0.35	**0.33**	0.32	0.30
Methionine+cystine,%	0.81	0.77	0.73	**0.69**	0.66	0.63	0.69	0.66	**0.63**	0.60	0.57	0.66	0.63	**0.60**	0.58	0.55	0.64	0.61	**0.58**	0.55	0.53
Threonine, %	0.66	0.62	0.59	**0.56**	0.54	0.51	0.56	0.53	**0.51**	0.49	0.47	0.55	0.52	**0.50**	0.47	0.46	0.53	0.50	**0.48**	0.46	0.44
Tryptophan, %	0.20	0.19	0.18	**0.17**	0.16	0.15	0.17	0.16	**0.15**	0.15	0.14	0.16	0.16	**0.15**	0.14	0.14	0.16	0.15	**0.14**	0.14	0.13
Arginine, %	0.98	0.93	0.88	**0.84**	0.80	0.76	0.83	0.79	**0.76**	0.72	0.69	0.81	0.77	**0.74**	0.71	0.68	0.79	0.75	**0.72**	0.68	0.66
Isoleucine, %	0.74	0.70	0.66	**0.63**	0.60	0.57	0.62	0.59	**0.57**	0.54	0.52	0.61	0.58	**0.55**	0.53	0.51	0.59	0.56	**0.54**	0.51	0.49
Valine, %	0.83	0.78	0.74	**0.71**	0.68	0.65	0.70	0.67	**0.64**	0.61	0.59	0.69	0.65	**0.62**	0.60	0.57	0.67	0.63	**0.61**	0.58	0.55
	Total Amino Acids[4]																				
Lysine, %	1.03	0.98	0.93	**0.88**	0.84	0.80	0.88	0.83	**0.80**	0.76	0.73	0.85	0.81	**0.78**	0.74	0.71	0.83	0.79	**0.75**	0.72	0.69
Methionine, %	0.50	0.47	0.45	**0.42**	0.40	0.39	0.42	0.40	**0.38**	0.37	0.35	0.41	0.39	**0.37**	0.36	0.34	0.39	0.37	**0.36**	0.34	0.33
Methionine+cystine,%	0.91	0.87	0.82	**0.78**	0.75	0.71	0.78	0.74	**0.71**	0.67	0.65	0.75	0.71	**0.68**	0.65	0.62	0.72	0.68	**0.65**	0.62	0.60
Threonine, %	0.78	0.74	0.70	**0.66**	0.63	0.61	0.66	0.63	**0.60**	0.57	0.55	0.64	0.61	**0.58**	0.56	0.54	0.62	0.59	**0.57**	0.54	0.52
Tryptophan, %	0.24	0.22	0.21	**0.20**	0.19	0.18	0.20	0.19	**0.18**	0.17	0.17	0.20	0.19	**0.18**	0.17	0.16	0.19	0.18	**0.17**	0.16	0.16
Arginine, %	1.05	1.00	0.95	**0.90**	0.86	0.82	0.90	0.85	**0.81**	0.78	0.75	0.87	0.83	**0.79**	0.76	0.73	0.85	0.81	**0.77**	0.74	0.71
Isoleucine, %	0.79	0.75	0.71	**0.68**	0.64	0.62	0.67	0.64	**0.61**	0.58	0.56	0.65	0.62	**0.59**	0.57	0.55	0.64	0.60	**0.58**	0.55	0.53
Valine, %	0.92	0.87	0.82	**0.78**	0.75	0.71	0.78	0.74	**0.71**	0.67	0.65	0.76	0.72	**0.69**	0.66	0.63	0.74	0.70	**0.67**	0.64	0.61
Crude protein[5], %	19.32	18.28	17.35	**16.50**	15.74	15.04	16.75	15.95	**15.23**	14.57	13.96	16.00	15.24	**14.55**	13.91	13.33	15.66	14.90	**14.22**	13.60	13.03
Calcium[6,8], %	4.77	4.52	4.29	**4.08**	3.89	3.72	4.30	4.10	**3.91**	3.74	3.58	4.50	4.29	**4.09**	3.91	3.75	4.65	4.42	**4.22**	4.04	3.87
Phosphorus (available)[7,8], %	0.52	0.49	0.47	**0.45**	0.43	0.41	0.42	0.40	**0.38**	0.37	0.35	0.38	0.36	**0.35**	0.33	0.32	0.37	0.36	**0.34**	0.32	0.31
Sodium, %	0.20	0.19	0.18	**0.17**	0.17	0.16	0.18	0.17	**0.16**	0.16	0.15	0.18	0.17	**0.16**	0.16	0.15	0.18	0.17	**0.17**	0.16	0.15
Chloride, %	0.20	0.19	0.18	**0.17**	0.17	0.16	0.18	0.17	**0.16**	0.16	0.15	0.18	0.17	**0.16**	0.16	0.15	0.18	0.17	**0.17**	0.16	0.15
Linoleic acid (C18:2 n-6), %	1.14	1.08	1.02	**0.97**	0.93	0.88	1.00	0.95	**0.91**	0.87	0.83	1.00	0.95	**0.91**	0.87	0.83	1.01	0.96	**0.92**	0.88	0.84

[1] Change to Layer 2 Diet when egg production has decreased 2% from peak egg production

[2] Crude protein, methionine+cystine, fat, linoleic acid, and / or energy may be changed to optimize egg size

[3] Recommended energy range is based on energy values shown in table at back of this guide. It is important that target concentrations of dietary energy are adjusted according to energy system applied to raw material matrix if values differ from those referred for raw materials in this guide

[4] Recommendation for Total Amino Acids is only appropriate to corn and soybean meal diet. Where diets utilize other ingredients, recommendations for Standardized Ileal Digestible Amino Acids must be followed

[5] Diets should always be formulated to provide required intake of amino acid. Concentration of Crude Protein in diet will vary with raw material used. Crude Protein value provided is an estimated typical value only

[6] Calcium carbonate particle size varies throughout lay. Refer to Calcium Particle Size Table (dietary calcium levels may need to be adjusted based on limestone solubility)

[7] Where other phosphorus systems are used, diets should contain recommended minimum level of available phosphorus

[8] For laying cycles beyond 75 weeks increase calcium to 4.8 grams / day and reduce available phosphorous to 360 mg / day

Non-Fast Molting Recommendations

(Check local regulations concerning molting)

Decision to molt is based on

- Projected feed costs
- Egg prices
- Differential prices between egg sizes
- Cost of pullet replacement
- Value of hens at end of lay
- Flock performance

Non-Fast Molting

- Hy-Line laying hens will perform very well after a rest
- Optimum age for molting is usually between 65 to 75 weeks of age
- Induced molting can extend the productive life of a flock by improving rate of lay, shell quality, and albumen height
- Post-molt performance will be lower than best pre-molt values
- Egg size will essentially remain unaffected and will continue to increase after egg production resumes
- Free access to water at all times
- High sodium levels in drinking water (i.e., 100 ppm or higher) can adversely affect non-fasting molt
- Reducing body weight to 18 week body weight (around 21–22% reduction) will result in best post-molt performance
- Best post-molt egg production is achieved after complete cessation of egg production that lasts for at least 2 weeks
- Goal is to maintain 18 week body weight (1.47–1.57 kg) during rest period
- After initial body weight loss, body weight can be held steady by combination of adjusting number of feedings per day and/or shift to higher-energy (laying-hen-type) diet
- Closely monitor body weight of flock during molt process
- Body weights should be collected twice per week from same cages every time
- Cages should be selected from bottom, middle and top tiers; all rows; and from front, middle and end of house

Non-Fast Molting Program

MOLT DAY	LIGHT (hours per day)	FEED TYPE	FEED MODIFICATION[1]	FEED INTAKE[2] (g / day per bird)	HOUSE TEMPERATURE[3] (°C)	COMMENTS
-7 to -5	16	Layer diet	Fine-particle $CaCO_3$	Full feed	24–25	Fine-particle $CaCO_3$ diet: Remove large-particle size $CaCO_3$ and replace with fine-particle $CaCO_3$ (less than 2 mm mean diameter). Do NOT change percent calcium in laying-hen diet
-4 to -1	24	Layer diet	Fine-particle $CaCO_3$, no added salt (NaCl)	Full feed	24–25	
0–6	6–8[4]	Molt diet[5]	Fine-particle $CaCO_3$	54–64	27–28	Higher house temperatures will reduce feed intake and facilitate reduction in body weight to 18 week target weight (Note: brown laying hens should not lose more than 21–22% of the pre-molt body weight)
7–17	6–8	Molt diet	—	54–64	27–28	Maintain body weight
18–19	12 or 16[6]	Layer diet[7]	Mixture of fine- and coarse-particle $CaCO_3$ as in a normal layer diet	64–73	27–28	Control (limit) feed intake to avoid fat birds
20–21	16[6]	Layer diet[7]	—	Full feed	26–27	Lower house temperature as needed to increase feed intake
22–24	16	Layer diet[7]	—	Full feed[7]	24–25	Lower ambient temperature to "normal"

[1] Include probiotic or complex-carbohydrate product (i.e., mannan-oligo-saccharide; MOS) at 0.5 kg per metric ton finished diet through all stages of molt program

[2] Feed intake depends on house temperature. Lower temperatures (colder) may require more feed

[3] Monitor air quality in house. Suggested house temperatures may not be achievable in cold weather

[4] Set lights at 8 hours or natural day length in open-sided houses. Normally not necessary to change light intensity

[5] Molt Diet is high in fiber (low in energy) and contains no added sodium (Na) (i.e., no added NaCl or $NaHCO_3$)

[6] Light stimulate birds to bring into production by increasing light hours to number of hours they were given before molt (i.e., 15 or 16 hours). Increase can be performed over 1 week (i.e., from 8 hours to 16 hours in a single day) or over 2 weeks (i.e., from 8 to 12 hours and then from 12 to 16 hours). Monitor and control feed intake for first few days after light stimulation to avoid fat birds as they return into lay (which would significantly increase egg weight in second cycle)

[7] According to post-molt nutrition recommendations

Molt Diet Recommendations

NUTRITION	RECOMMENDED CONCENTRATION[1]
Metabolizable energy[2], kcal/kg	2600–2800
Metabolizable energy[2], MJ/kg	10.90–11.70
	Standardized Ileal Digestible Amino Acids / Total Amino Acids[3]
Lysine, %	**0.30** / 0.33
Methionine, %	**0.15** / 0.16
Methionine+cystine,%	**0.32** / 0.36
Threonine, %	**0.18** / 0.21
Tryptophan, %	**0.10** / 0.12
Arginine, %	**0.38** / 0.41
Isoleucine, %	**0.18** / 0.20
Valine, %	**0.23** / 0.26
Crude protein[4], %	8.50
Calcium[5], %	1.3–2.0
Phosphorus (available), %	0.25
Sodium[6], %	0.03
Chloride, %	0.03

[1] Crude protein, methionine+cystine, fat, linoleic acid, and / or energy may be changed to optimize egg size

[2] Recommended energy range is based on energy values shown in table at back of this guide. It is important that target concentrations of dietary energy are adjusted according to energy system applied to raw material matrix if values differ from those referred for raw materials in this guide

[3] Recommendation for Total Amino Acids is only appropriate to corn and soybean meal diet. Where diets utilize other ingredients, recommendations for Standardized Ileal Digestible Amino Acids must be followed

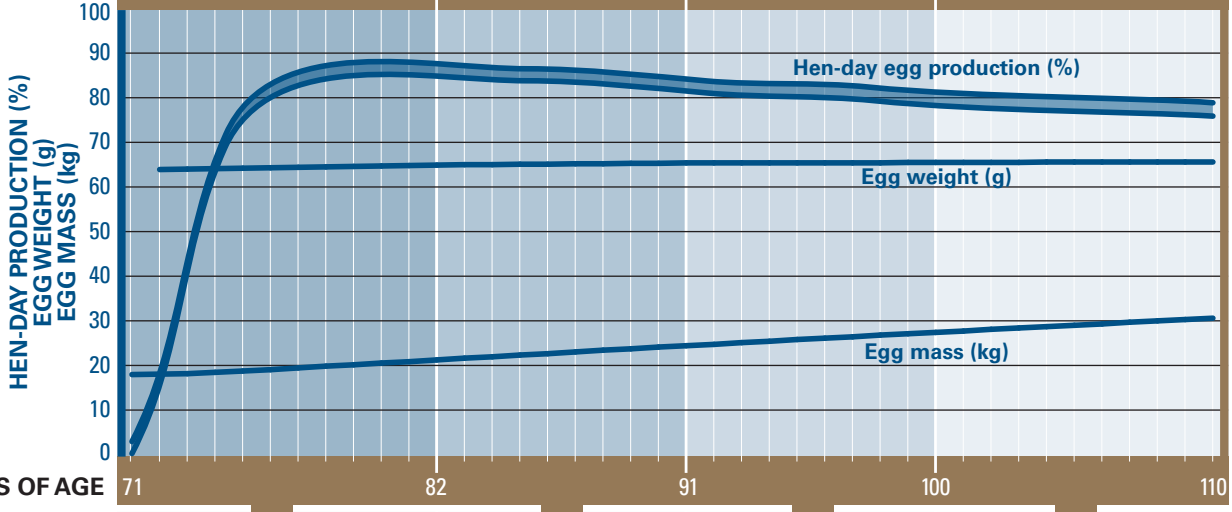
[4] Diets should always be formulated to provide required intake of amino acid. Concentration of Crude Protein in diet will vary with raw material used and Crude Protein value provided is an estimated typical value only

[5] Calcium carbonate should be in particle sizes of less than 2 mm

[6] Sodium content in Molt Diet should not exceed 0.035%

Post-Molt Nutrition Recommendations

FEEDING PHASE	POST-MOLT 1	POST-MOLT 2	POST-MOLT 3	POST-MOLT 4
PRODUCTION	Peak to 86%	85-82%	81-79%	< 79%



NUTRITION	RECOMMENDED CONCENTRATION[1]			
Metabolizable energy[2], kcal/kg	2538–2811	2538–2811	2538–2811	2538–2811
Metabolizable energy[2], MJ/kg	10.62–11.77	10.62–11.77	10.62–11.77	10.62–11.77

RECOMMENDED DAILY INTAKE	Standardized Ileal Digestible Amino Acids / Total Amino Acids[3]			
Lysine, mg/day	**713** / 780	**713** / 780	**713** / 780	**713** / 780
Methionine, mg/day	**342** / 368	**342** / 368	**342** / 368	**342** / 368
Methionine+cystine, mg/day	**599** / 675	**599** / 675	**599** / 675	**599** / 675
Threonine, mg/day	**499** / 587	**499** / 587	**499** / 587	**499** / 587
Tryptophan, mg/day	**150** / 179	**150** / 179	**150** / 179	**150** / 179
Arginine, mg/day	**741** / 797	**741** / 797	**741** / 797	**741** / 797
Isoleucine, mg/day	**556** / 598	**556** / 598	**556** / 598	**556** / 598
Valine, mg/day	**627** / 692	**627** / 692	**627** / 692	**627** / 692
Crude protein[4], g/day	14.73	14.73	14.73	14.73
Calcium[5], g/day	4.70	4.90	5.10	5.30
Phosphorus (available)[6], mg/day	440	400	380	340
Sodium, mg/day	180	180	180	180
Chloride, mg/day	180	180	180	180
Linoleic acid (C18:2 n-6), g/day	1.00	1.00	1.00	1.00
Choline, mg/day	100	100	100	100

RECOMMENDED POST-MOLT DIETARY CALCIUM AND PHOSPHORUS	Post-Molt 1					Post-Molt 2					Post-Molt 3					Post-Molt 4				
Feed consumption, g/day/bird	93	98	**103**	108	113	100	105	**110**	115	120	100	105	**110**	115	120	99	104	**109**	114	119
Calcium[5], %	5.05	4.80	**4.56**	4.35	4.16	4.90	4.67	**4.45**	4.26	4.08	5.10	4.86	**4.64**	4.43	4.25	5.35	5.10	**4.86**	4.65	4.45
Phosphorus (available)[6], %	0.47	0.45	**0.43**	0.41	0.39	0.40	0.38	**0.36**	0.35	0.33	0.38	0.36	**0.35**	0.33	0.32	0.34	0.33	**0.31**	0.30	0.29

[1] Crude protein, methionine+cystine, fat, linoleic acid, and / or energy may be changed to optimize egg size

[2] Recommended energy range is based on energy values shown in table at back of this guide. It is important that target concentrations of dietary energy are adjusted according to energy system applied to raw material matrix if values differ from those referred for raw materials in this guide

[3] Recommendation for Total Amino Acids is only appropriate to corn and soybean meal diet. Where diets utilize other ingredients, recommendations for Standardized Ileal Digestible Amino Acids must be followed

[4] Diets should always be formulated to provide required intake of amino acid. Concentration of Crude Protein in diet will vary with raw material used. Crude Protein value provided is an estimated typical value only

[5] 65% of calcium carbonate should be in 2-4 mm particle size

[6] Where other phosphorus systems are used, diets should contain recommended minimum level of available phosphorus

Disease Control

A flock of pullets or layers can only perform up to its genetic potential when disease influence is minimized. 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 diseases. A good biosecurity program identifies and controls the most likely ways a disease could enter the farm.

- Human and equipment movement onto farm should be strictly controlled
- Visitors to farm should be limited to those essential for its operation
- Visits should be documented in logbook
- All visitors and workers should shower at central location before entering
- Clean boots, clothing and head cover should be provided for workers and visitors
- Clean footbaths containing disinfectant should be placed outside 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
- For those visiting a number of flocks, flocks visited on one day should be limited. Always progress from younger to older and from healthy to sick flocks. After visiting a sick flock, no other houses should be entered
- Removal of flocks from farm is an opportunity for disease to be introduced as trucks and crews have often been on other farms
- A single-aged growing farm using all-in, all-out principle is best to prevent transmission of disease from older flocks to younger, susceptible flocks
- Houses should be designed to prevent exposure to wild birds, insects and rodents
- Quickly and properly dispose of dead chickens

Rodents

Rodents are known carriers of many poultry diseases and the most common reason for re-contamination of a cleaned and disinfected poultry facility. Also responsible for house-to-house spread of disease on a farm

- Farm should be free of debris and tall grass that provide a hiding area for rodents
- Perimeter of house should have 1 m wide area of crushed rock or concrete to prevent rodents from burrowing into houses
- Feed and eggs should be stored in rodent-proof areas
- Bait stations should be placed throughout house and maintained with fresh rodenticide

Cleaning and Disinfection

Cleaning and disinfection of house between flocks reduces infection pressure for next flock

- Allow minimum of 2 weeks downtime between flocks
- All feed and manure should be removed from house before cleaning
- Thoroughly clean air inlets, fan housing, fan blades and fan louvers
- Heating house during washing improves removal of organic matter
- House should be cleaned of organic matter with high pressure spraying of warm water
- Use foam / gel detergent to soak into organic matter and equipment
- Wash upper portion of house before pit
- Use high pressure warm water to rinse
- Allow house to dry
- After fully dry, apply foam / spray disinfectant followed by fumigation
- Flush and sanitize water lines
- Monitoring of poultry houses for presence of Salmonella, particularly *Salmonella enteritidis*, is recommended by routine environmental testing
- Allow house to dry before repopulating

Vertically Transmitted Diseases

- Some diseases are known to be transmitted from infected breeders to progeny
- Disease-free breeders is first step in control of these diseases for commercial layers
- All breeders directly under Hy-Line International's control are free of *Mycoplasma gallisepticum, Mycoplasma synoviae, Salmonella pullorum, Salmonella gallinarum, Salmonella enteritidis, Salmonella typhimurium* and lymphoid leukosis
- Due to possibility of horizontal transmission of these diseases, later generations may not remain free
- It is responsibility of breeding and commercial flock owners to prevent horizontal transmission of these diseases and continue testing to be assured of a negative status

COCCIDIA

This parasitic infection of the intestines may lead to gut damage and, in severe infestations, death. More commonly, poor control of sub-clinical infection reduces feed conversion or leaves pullets with chronic, irreversible gut damage. Pullet flocks may be uneven or underweight at housing and not perform to their full potential in lay. Control of coccidia includes the following measures (check local regulations):

- Use ionophores or chemicals on a step-down program to ensure immunity in pullets
- Live vaccine use is an alternative to anti-coccidial drug treatments
- Live vaccines are available that can be administered by spray in hatchery or by feed or water application during first few days in brooder house
- Thorough cleaning and disinfection of houses reduces challenge pressure
- Limit bird access to manure belts
- Rearing and production in cages limits exposure to coccidia oocytes in feces

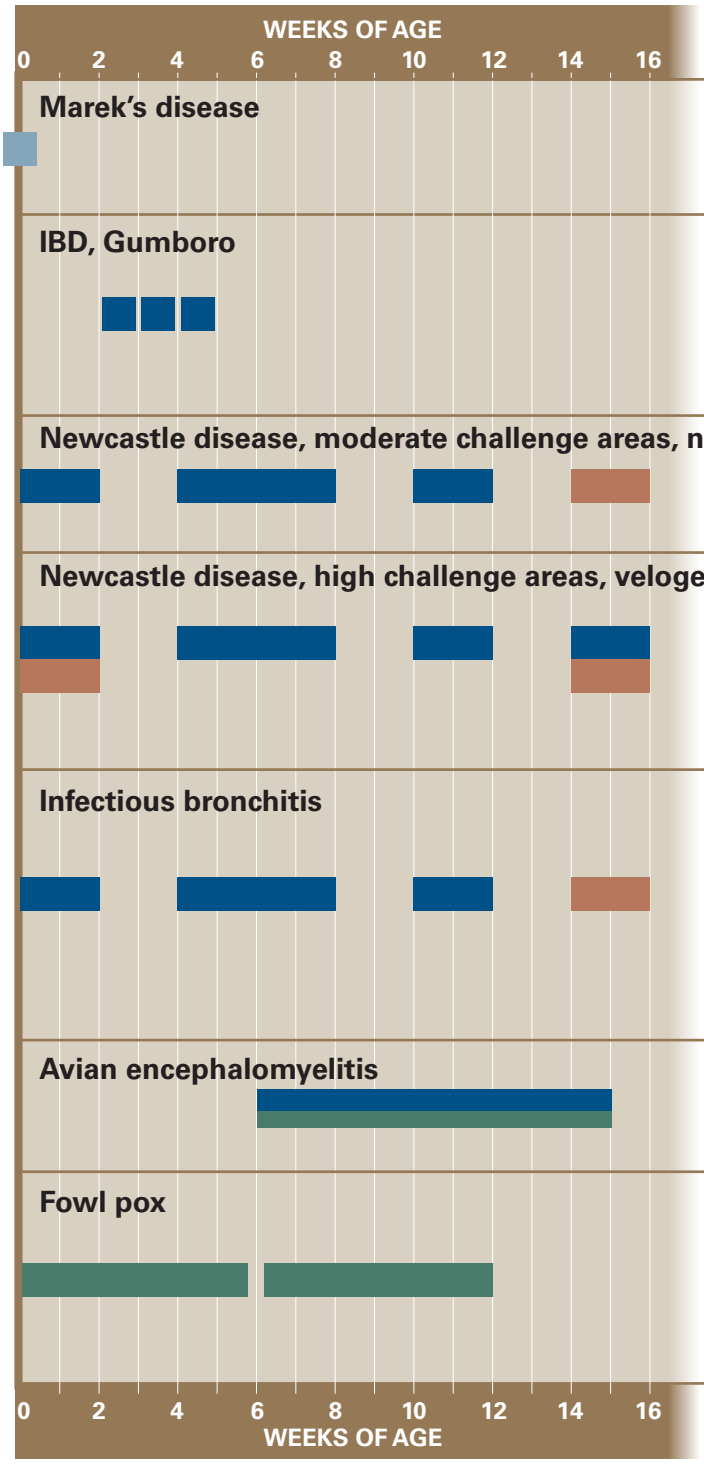
Vaccination Recommendations

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 disease (NDV), infectious bronchitis (IB), infectious bursal disease (IBD or Gumboro), avian encephalomyelitis (AE) and fowl pox.

A single program cannot be recommended for all regions. Consult with local veterinarians to determine the best vaccination program for your area.

BASIC COMMERCIAL LAYER VACCINE APPLICATIONS



Marek's disease

- All commercial layers should be vaccinated with Marek's vaccine in hatchery
- Rispens or Rispens / HVT vaccine preferred
- HVT / SB1 used in low challenge areas

IBD, Gumboro

- Given between days 15–18, 21–25, 28–32, IBD live vaccinations based on maternal antibody decline and field challenge
- Drinking water vaccination preferred
- HVT—IBD vector vaccine available for hatchery administration

Newcastle disease, moderate challenge areas, no velogenic Newcastle present

- 2–3 live vaccinations, allow 4–6 weeks between last live vaccination and injected inactivated vaccine

Newcastle disease, high challenge areas, velogenic Newcastle present

- Simultaneous live (eye drop) and inactivated vaccine provides good protection in high challenge areas
- Live boosting vaccinations every 30–60 days during production period may be needed to maintain high immunity

Infectious bronchitis

- Use Newcastle-bronchitis combination vaccines
- 2-3 live vaccinations using multiple IB serotypes build cross-protective immunity (if serotypes have been identified in the area)
- Last live vaccination should be administered as a spray
- Live boosting vaccinations every 30–60 days during production period may be needed to maintain high immunity

Avian encephalomyelitis

- Given once between 6 and 15 weeks to prevent egg drops
- Given via drinking water or often combined with fowl pox vaccine as a wing-web inoculation

Fowl pox

- 1 or 2 vaccinations
- Vaccination in birds less than 6 weeks should use highly attenuated fowl pox vaccine or pigeon pox
- Use pigeon pox with fowl pox to provide better cross-protection
- Most outbreaks due to poor vaccination technique

Live hatchery vaccines, given subcutaneous

Live vaccines, administered by drinking water, spray or eyedrop

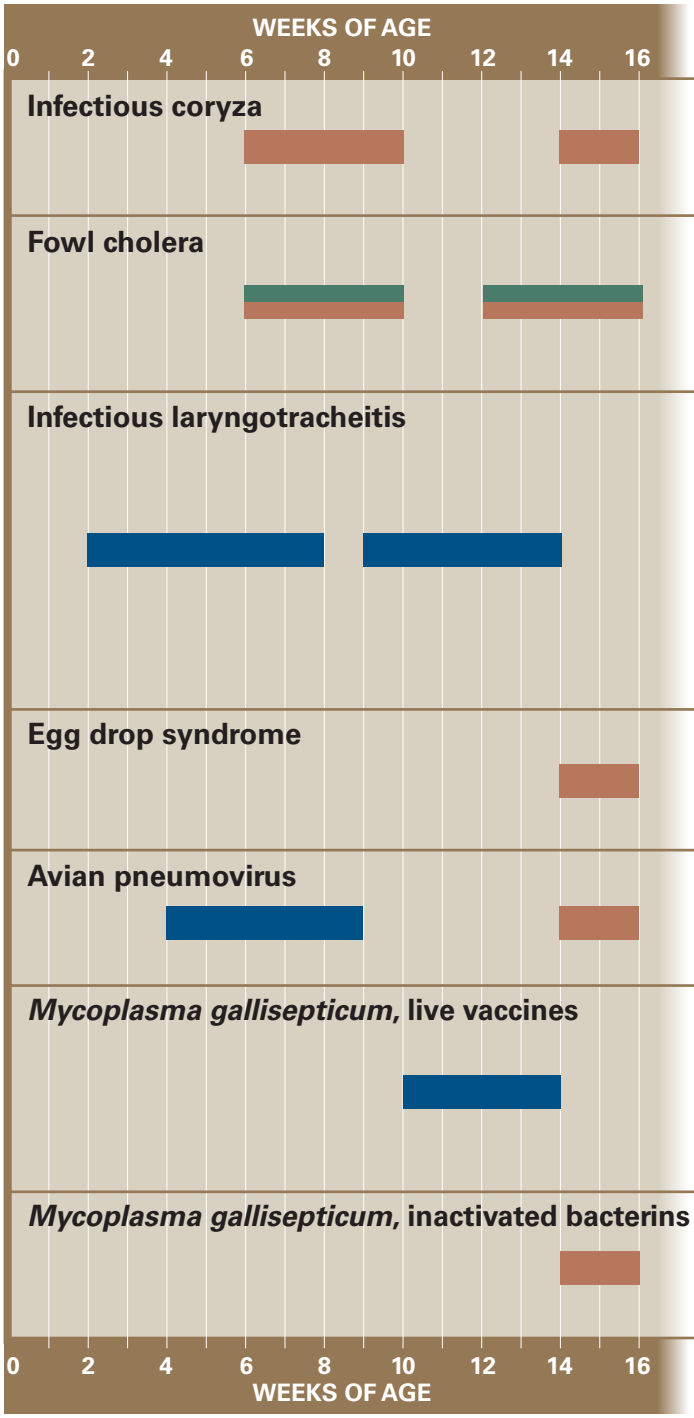
Live vaccines, administered via wing-web inoculation

Inactivated vaccines, injected via intramuscular or subcutaneous route

Vaccination Recommendations *(continued)*

OPTIONAL COMMERCIAL LAYER VACCINE APPLICATIONS

Use if these diseases are prevalent in the area, consult a local veterinarian for advice in designing an effective vaccination program for your farm.



Infectious coryza

- 2 vaccinations separated by 4 weeks
- Autogenous vaccines utilizing local isolates are sometimes used

Fowl cholera

- 2 vaccinations separated by 4 weeks
- Autogenous vaccines utilizing local isolates are sometimes used
- Live cholera vaccines such as M-9 or PM-1 are also used

Infectious laryngotracheitis

- 2 vaccinations
- Eye drop is the preferred method of vaccination
- Do not vaccinate within 7 days of another live respiratory vaccine
- Many ILT outbreaks are due to unwanted spread of ILT vaccine
- ILT-HVT vector vaccine available for hatchery administration
- ILT-pox vector vaccine available

Egg drop syndrome

- 1 vaccination is highly effective

Avian pneumovirus

- Live and inactivated vaccines available
- A vaccination program using both live and killed vaccines is most effective

***Mycoplasma gallisepticum*, live vaccines**

- Live vaccines can control economic impact of MG infection
- TS-11, 6 / 85 and F-strain vaccines available
- Use F-strain for stronger protection

***Mycoplasma gallisepticum*, inactivated bacterins**

- Inactivated MG bacterins available
- Often MG bacterins are in combination with Newcastle and bronchitis

Live hatchery vaccines, given subcutaneous

Live vaccines, administered by drinking water, spray or eyedrop

Live vaccines, administered via wing-web inoculation

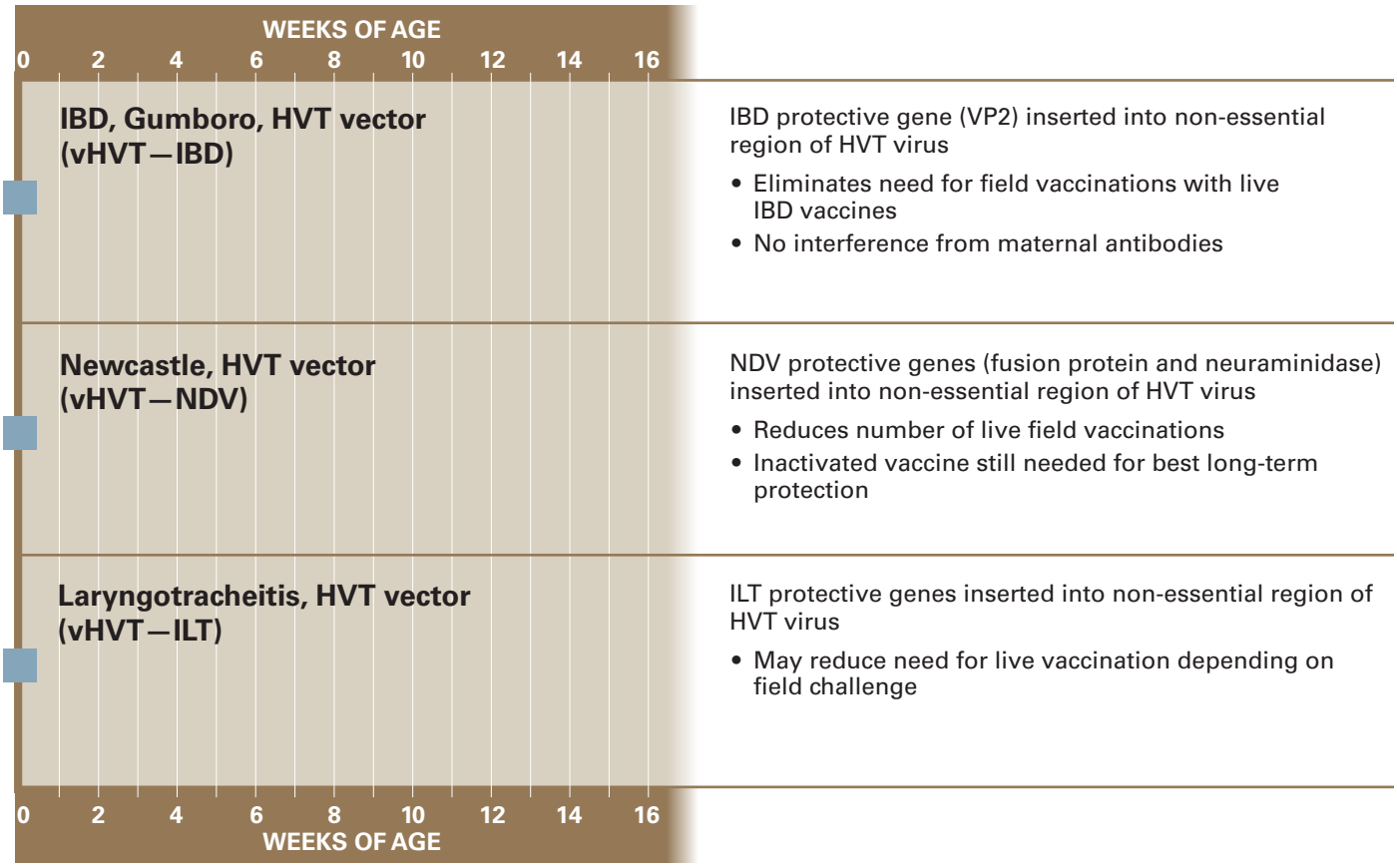
Inactivated vaccines, injected via intramuscular or subcutaneous route

Vaccination Recommendations *(continued)*

RECOMBINANT HVT VACCINES

Vaccines using recombinant vector technology offer the convenience of hatchery administration with no adverse effects caused by some live field vaccinations. For best Marek's disease protection use Rispens vaccine in combination with recombinant HVT vaccine.

CAUTION: Do not use another HVT vaccine when using HVT-vectored vaccines.



Live hatchery vaccines, given subcutaneous

Live vaccines, administered by drinking water, spray or eyedrop

Live vaccines, administered via wing-web inoculation

Inactivated vaccines, injected via intramuscular or subcutaneous route

Performance Standards

AGE (weeks)	% HEN-DAY Current	HEN-DAY EGGS Cumulative	HEN-HOUSED EGGS Cumulative	MORTALITY Cumulative (%)	BODY WEIGHT (kg)	FEED CONSUMPTION (g / day per bird)	HEN-HOUSED EGG MASS Cumulative (kg)	AVERAGE EGG WEIGHT* (g / egg)
18	4 – 14	0.3 – 1.0	0.3 – 1.0	0.0	1.47 – 1.57	82 – 88	0.0	48.8 – 50.0
19	24 – 38	2.0 – 3.6	2.0 – 3.6	0.1	1.57 – 1.67	85 – 91	0.1	49.0 – 51.0
20	45 – 72	5.1 – 8.7	5.1 – 8.7	0.1	1.63 – 1.73	91 – 97	0.3	50.2 – 52.2
21	75 – 86	10.4 – 14.7	10.3 – 14.7	0.2	1.67 – 1.77	95 – 101	0.5	51.5 – 53.6
22	87 – 92	16.5 – 21.1	16.4 – 21.1	0.3	1.72 – 1.82	99 – 105	0.9	53.1 – 55.3
23	92 – 94	22.9 – 27.7	22.8 – 27.7	0.3	1.75 – 1.85	103 – 109	1.2	54.4 – 56.6
24	92 – 95	29.3 – 34.4	29.2 – 34.3	0.4	1.78 – 1.90	105 – 111	1.6	55.5 – 57.7
25	93 – 95	35.8 – 41.0	35.7 – 40.9	0.4	1.79 – 1.91	106 – 112	2.0	56.6 – 59.0
26	94 – 96	42.4 – 47.7	42.3 – 47.6	0.5	1.80 – 1.92	107 – 113	2.3	57.3 – 59.7
27	95 – 96	49.1 – 54.5	48.9 – 54.3	0.6	1.82 – 1.94	107 – 113	2.7	58.4 – 60.8
28	95 – 96	55.7 – 61.2	55.5 – 60.9	0.6	1.83 – 1.95	107 – 113	3.1	59.0 – 61.4
29	95 – 96	62.4 – 67.9	62.1 – 67.6	0.7	1.84 – 1.96	107 – 113	3.5	59.3 – 61.7
30	94 – 96	69.0 – 74.6	68.6 – 74.3	0.7	1.84 – 1.96	107 – 113	3.9	59.7 – 62.1
31	94 – 96	75.5 – 81.3	75.1 – 80.9	0.8	1.84 – 1.96	108 – 114	4.3	59.9 – 62.3
32	94 – 95	82.1 – 88.0	81.7 – 87.5	0.9	1.85 – 1.97	108 – 114	4.7	60.1 – 62.5
33	94 – 95	88.7 – 94.6	88.2 – 94.1	0.9	1.85 – 1.97	108 – 114	5.1	60.3 – 62.7
34	94 – 95	95.3 – 101.3	94.7 – 100.7	1.0	1.85 – 1.97	108 – 114	5.5	60.5 – 62.9
35	94 – 95	101.9 – 107.9	101.2 – 107.3	1.0	1.85 – 1.97	108 – 114	5.9	60.6 – 63.0
36	93 – 94	108.4 –114.5	107.6 – 113.8	1.1	1.86 – 1.98	108 – 114	6.3	60.7 – 63.1
37	93 – 94	114.9 – 121.1	114.1 – 120.3	1.2	1.86 – 1.98	108 – 114	6.7	60.8 – 63.2
38	93 – 94	121.4 – 127.7	120.5 – 126.8	1.2	1.86 – 1.98	108 – 114	7.1	60.9 – 63.3
39	92 – 93	127.8 – 134.2	126.9 – 133.2	1.3	1.87 – 1.99	108 – 114	7.5	61.0 – 63.4
40	92 – 93	134.3 – 140.7	133.2 – 139.6	1.4	1.87 – 1.99	108 – 114	7.9	61.1 – 63.5
41	91 – 93	140.6 – 147.2	139.5 – 146.0	1.4	1.87 – 1.99	108 – 114	8.3	61.2 – 63.6
42	91 – 92	147.0 – 153.7	145.8 – 152.4	1.5	1.88 – 2.00	108 – 114	8.7	61.3 – 63.9
43	90 – 92	153.3 – 160.1	152.0 – 158.7	1.6	1.88 – 2.00	108 – 114	9.1	61.5 – 64.1
44	90 – 92	159.6 – 166.5	158.1 – 165.0	1.6	1.88 – 2.00	108 – 114	9.5	61.6 – 64.2
45	89 – 91	165.8 – 172.9	164.3 – 171.3	1.7	1.89 – 2.01	107 – 113	9.9	61.6 – 64.2
46	89 – 91	172.1 – 179.3	170.4 – 177.6	1.8	1.89 – 2.01	107 – 113	10.3	61.7 – 64.3
47	88 – 90	178.2 – 185.6	176.4 – 183.7	1.9	1.89 – 2.01	107 – 113	10.6	61.8 – 64.4
48	88 – 90	184.4 – 191.9	182.5 – 189.9	1.9	1.89 – 2.01	107 – 113	11.0	61.9 – 64.5
49	88 – 90	190.5 – 198.2	188.5 – 196.1	2.0	1.89 – 2.01	107 – 113	11.4	62.0 – 64.6
50	88 – 89	196.7 – 204.4	194.5 – 202.2	2.1	1.89 – 2.01	107 – 113	11.8	62.1 – 64.7
51	87 – 89	202.8 – 210.6	200.5 – 208.3	2.1	1.89 – 2.01	106 – 112	12.2	62.1 – 64.7
52	87 – 89	208.9 – 216.9	206.4 – 214.4	2.2	1.89 – 2.01	106 – 112	12.5	62.2 – 64.8
53	87 – 88	215.0 – 223.0	212.4 – 220.4	2.3	1.89 – 2.01	106 – 112	12.9	62.2 – 64.8
54	87 – 88	221.1 – 229.2	218.3 – 226.4	2.3	1.89 – 2.01	106 – 112	13.3	62.2 – 64.8
55	86 – 88	227.1 – 235.3	224.2 – 232.4	2.4	1.90 – 2.02	106 – 112	13.7	62.2 – 64.8
56	86 – 87	233.1 – 241.4	230.1 – 238.4	2.5	1.90 – 2.02	106 – 112	14.0	62.3 – 64.9
57	85 – 87	239.1 – 247.5	235.9 – 244.3	2.6	1.90 – 2.02	106 – 112	14.4	62.3 – 64.9
58	85 – 87	245.0 – 253.6	241.7 – 250.2	2.6	1.90 – 2.02	106 – 112	14.8	62.3 – 64.9
59	85 – 87	251.0 – 259.7	247.5 – 256.1	2.7	1.90 – 2.02	106 – 112	15.1	62.4 – 65.0
60	84 – 86	256.8 – 265.7	253.2 – 262.0	2.8	1.90 – 2.02	106 – 112	15.5	62.4 – 65.0

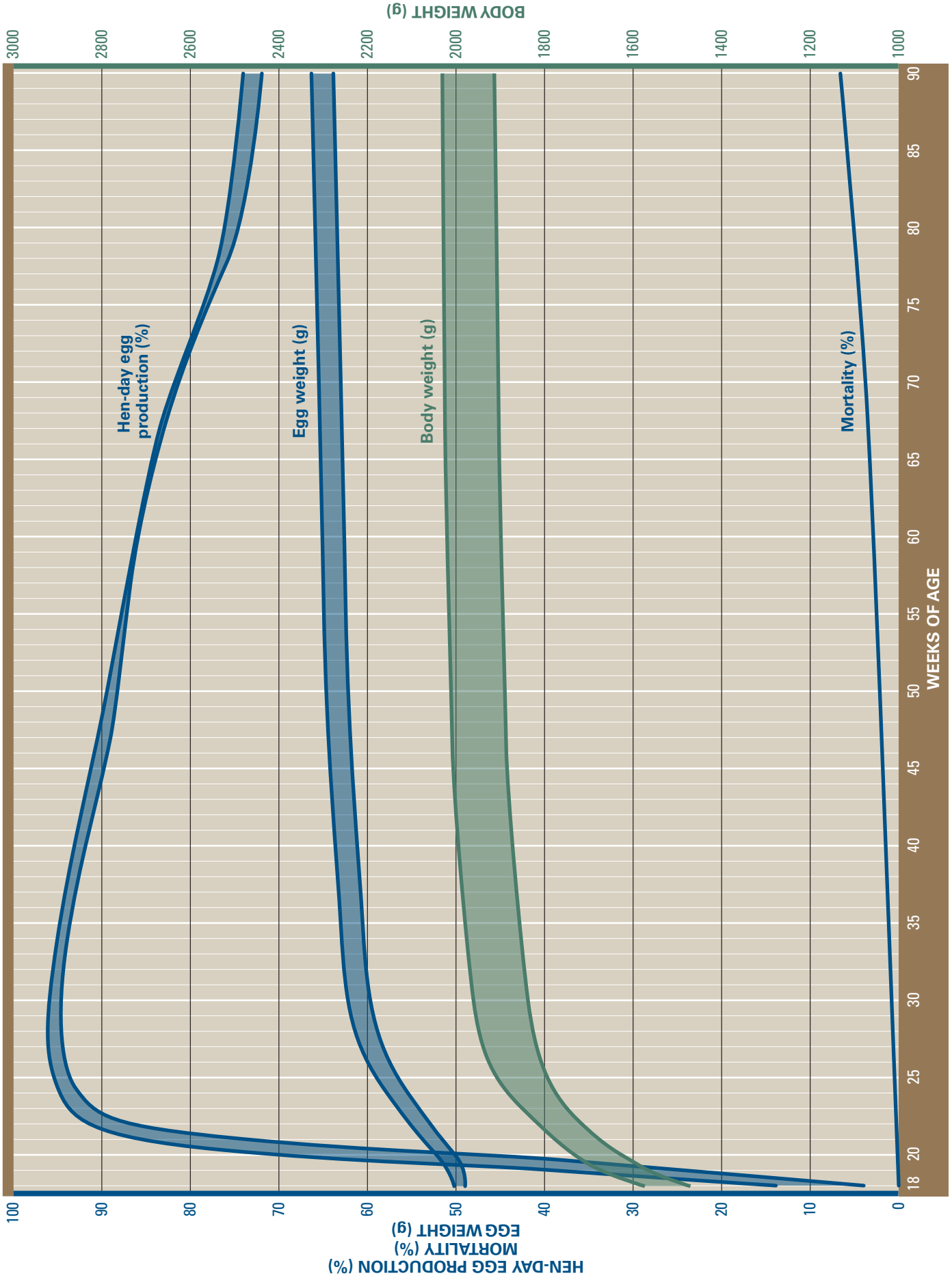
* Egg weights after 40 weeks of age assume phase feeding of protein to limit egg size

Performance Standards *(continued)*

AGE (weeks)	% HEN-DAY Current	HEN-DAY EGGS Cumulative	HEN-HOUSED EGGS Cumulative	MORTALITY Cumulative (%)	BODY WEIGHT (kg)	FEED CONSUMPTION (g / day per bird)	HEN-HOUSED EGG MASS Cumulative (kg)	AVERAGE EGG WEIGHT* (g / egg)
61	84 – 86	262.7 – 271.7	258.9 – 267.8	2.9	1.90 – 2.02	106 – 112	15.9	62.5 – 65.1
62	83 – 86	268.5 – 277.8	264.5 – 273.7	2.9	1.90 – 2.02	106 – 112	16.2	62.5 – 65.1
63	83 – 85	274.3 – 283.7	270.1 – 279.4	3.0	1.90 – 2.02	106 – 112	16.6	62.6 – 65.2
64	83 – 85	280.1 – 289.7	275.8 – 285.2	3.1	1.90 – 2.02	106 – 112	16.9	62.6 – 65.2
65	83 – 85	286.0 – 295.6	281.4 – 291.0	3.2	1.90 – 2.02	106 – 112	17.3	62.7 – 65.3
66	82 – 84	291.7 – 301.5	286.9 – 296.6	3.3	1.90 – 2.02	106 – 112	17.7	62.7 – 65.3
67	81 – 84	297.4 – 307.4	292.4 – 302.3	3.4	1.90 – 2.02	106 – 112	18.0	62.8 – 65.4
68	81 – 83	303.0 – 313.2	297.9 – 307.9	3.5	1.90 – 2.02	106 – 112	18.4	62.8 – 65.4
69	81 – 82	308.7 – 318.9	303.3 – 313.4	3.7	1.90 – 2.02	106 – 112	18.7	62.9 – 65.5
70	80 – 82	314.3 – 324.7	308.7 – 319.0	3.8	1.91 – 2.03	106 – 112	19.1	62.9 – 65.5
71	79 – 81	319.8 – 330.3	314.0 – 324.4	3.9	1.91 – 2.03	106 – 112	19.4	63.0 – 65.6
72	79 – 81	325.4 – 336.0	319.3 – 329.9	4.0	1.91 – 2.03	106 – 112	19.7	63.0 – 65.6
73	78 – 80	330.8 – 341.6	324.6 – 335.2	4.1	1.91 – 2.03	106 – 112	20.1	63.1 – 65.7
74	77 – 80	336.2 –347.2	329.7 – 340.6	4.3	1.91 – 2.03	106 – 112	20.4	63.1 – 65.7
75	76 – 79	341.5 – 352.7	334.8 – 345.9	4.4	1.91 – 2.03	106 – 112	20.7	63.2 – 65.8
76	76 – 78	346.9 – 358.2	339.9 – 351.1	4.5	1.91 – 2.03	106 – 112	21.1	63.2 – 65.8
77	75 – 77	352.1 – 363.6	344.9 – 356.2	4.7	1.91 – 2.03	106 – 112	21.4	63.3 – 65.9
78	75 – 77	357.4 – 369.0	349.9 – 361.3	4.8	1.91 – 2.03	106 – 112	21.7	63.3 – 65.9
79	74 – 77	362.5 – 374.4	354.8 – 366.5	5.0	1.91 – 2.03	106 – 112	22.0	63.4 – 66.0
80	74 – 76	367.7 – 379.7	359.7 – 371.5	5.1	1.91 – 2.03	106 – 112	22.4	63.5 – 66.1
81	74 – 76	372.9 – 385.0	364.6 – 376.5	5.3	1.91 – 2.03	106 – 112	22.7	63.5 – 66.1
82	74 – 76	378.1 – 390.3	369.5 – 381.6	5.4	1.91 – 2.03	106 – 112	23.0	63.5 – 66.1
83	73 – 75	383.2 – 395.6	374.4 – 386.5	5.6	1.91 – 2.03	106 – 112	23.3	63.6 – 66.2
84	73 – 75	388.3 – 400.8	379.2 – 391.5	5.7	1.91 – 2.03	106 – 112	23.6	63.6 – 66.2
85	73 – 75	393.4 – 406.1	384.0 – 396.4	5.9	1.91 – 2.03	106 – 112	23.9	63.6 – 66.2
86	73 – 75	398.5 – 411.3	388.8 – 401.4	6.0	1.91 – 2.03	106 – 112	24.2	63.6 – 66.2
87	72 – 74	403.6 – 416.5	393.5 – 406.2	6.2	1.91 – 2.03	106 – 112	24.5	63.7 – 66.3
88	72 – 74	408.6 – 421.7	398.2 – 411.1	6.3	1.91 – 2.03	106 – 112	24.9	63.7 – 66.3
89	72 – 74	413.6 – 426.9	402.9 – 415.9	6.5	1.91 – 2.03	106 – 112	25.2	63.7 – 66.3
90	72 – 74	418.7 – 432.0	407.7 – 420.7	6.6	1.91 – 2.03	106 – 112	25.5	63.7 – 66.3

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

Performance Standards Graph

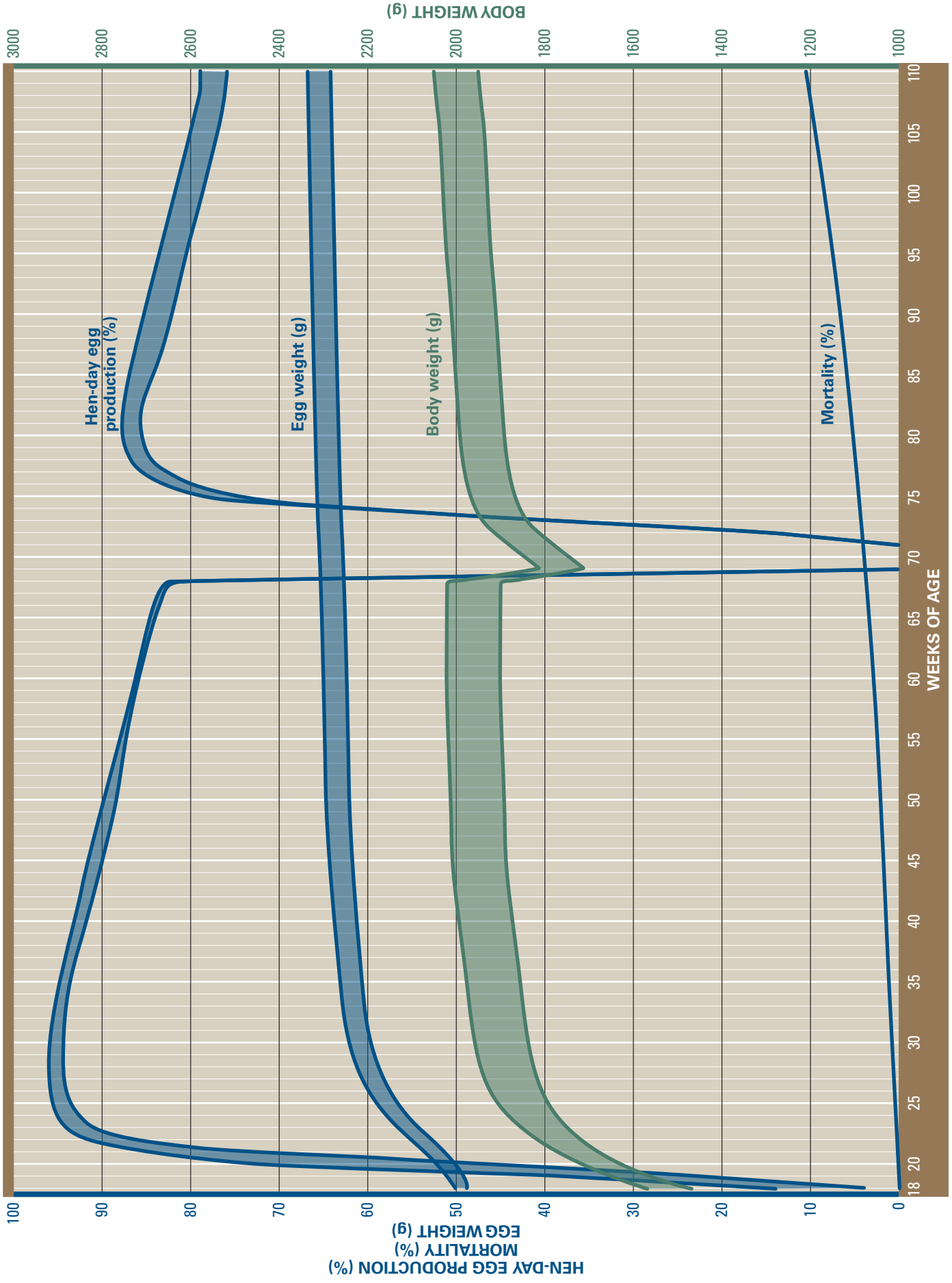


Post-Molt Performance Standards

AGE (weeks)	% HEN–DAY Current	HEN–DAY EGGS Cumulative	HEN–HOUSED EGGS Cumulative	MORTALITY Cumulative (%)	BODY WEIGHT (kg)	FEED CONSUMPTION (g / day per bird)	HEN–HOUSED EGG MASS Cumulative (kg)	AVERAGE EGG WEIGHT* (g / egg)
69	0 – 0	299.2 – 309.4	294.1 – 304.2	3.7	1.71 – 1.81	– – –	18.0	–
70	0 – 0	299.2 – 309.4	294.1 – 304.2	3.9	1.74 – 1.84	0.0 – 0.0	18.0	–
71	0 – 0	299.2 – 309.4	294.1 – 304.2	4.1	1.77 – 1.87	0.0 – 0.0	18.0	–
72	12 – 15	300.0 – 310.4	294.9 – 305.2	4.2	1.81 – 1.91	85.0 – 95.0	18.1	64.0
73	38 – 41	302.7 – 313.3	297.4 – 307.9	4.3	1.85 – 1.95	90.0 – 100.0	18.2	64.1
74	62 – 65	307.0 – 317.8	301.6 – 312.3	4.4	1.86 – 1.96	95.0 – 105.0	18.5	64.2
75	76 – 79	312.3 – 323.4	306.7 – 317.6	4.5	1.87 – 1.97	100.0 – 110.0	18.8	64.3
76	80 – 83	317.9 – 329.2	312.0 – 323.1	4.6	1.88 – 1.98	103.0 – 113.0	19.2	64.4
77	82 – 85	323.7 – 335.1	317.5 – 328.8	4.7	1.88 – 1.98	104.0 – 114.0	19.5	64.5
78	85 – 87	329.6 – 341.2	323.1 – 334.6	4.9	1.88 – 1.98	105.0 – 115.0	19.9	64.6
79	85 – 87	335.6 – 347.3	328.8 – 340.4	5.0	1.88 – 1.98	106.0 – 116.0	20.2	64.7
80	85 – 87	341.5 – 353.4	334.4 – 346.1	5.1	1.89 – 1.99	107.0 – 117.0	20.6	64.8
81	86 – 88	347.5 – 359.6	340.1 – 352.0	5.2	1.89 – 1.99	107.0 – 117.0	21.0	64.9
82	86 – 88	353.5 – 365.7	345.8 – 357.8	5.4	1.90 – 2.00	108.0 – 118.0	21.3	65.0
83	85 – 87	359.5 – 371.8	351.5 – 363.6	5.5	1.90 – 2.00	108.0 – 118.0	21.7	65.1
84	85 – 87	365.4 – 377.9	357.1 – 369.3	5.7	1.90 – 2.00	109.0 – 119.0	22.1	65.1
85	84 – 87	371.3 – 384.0	362.6 – 375.0	5.8	1.91 – 2.01	109.0 – 119.0	22.4	65.2
86	84 – 87	377.2 – 390.1	368.1 – 380.8	6.0	1.91 – 2.01	110.0 – 120.0	22.8	65.2
87	83 – 86	383.0 – 396.1	373.6 – 386.4	6.1	1.91 – 2.01	110.0 – 120.0	23.2	65.3
88	83 – 86	388.8 – 402.1	379.0 – 392.1	6.3	1.91 – 2.01	110.0 – 120.0	23.5	65.3
89	83 – 86	394.6 – 408.1	384.5 – 397.7	6.4	1.91 – 2.01	110.0 – 120.0	23.9	65.4
90	82 – 85	400.4 – 414.1	389.8 – 403.3	6.6	1.92 – 2.02	110.0 – 120.0	24.2	65.4
91	82 – 85	406.1 – 420.0	395.2 – 408.8	6.8	1.92 – 2.02	110.0 – 120.0	24.6	65.5
92	81 – 84	411.8 – 425.9	400.5 – 414.3	6.9	1.92 – 2.02	111.0 – 121.0	24.9	65.5
93	81 – 84	417.5 – 431.8	405.7 – 419.7	7.1	1.92 – 2.02	111.0 – 121.0	25.3	65.5
94	81 – 84	423.1 – 437.7	411.0 – 425.2	7.3	1.92 – 2.02	111.0 – 121.0	25.6	65.5
95	80 – 83	428.7 – 443.5	416.2 – 430.6	7.4	1.92 – 2.02	110.0 – 120.0	25.9	65.5
96	80 – 83	434.3 – 449.3	421.4 – 435.9	7.6	1.93 – 2.03	110.0 – 120.0	26.3	65.5
97	80 – 83	439.9 – 455.1	426.5 – 441.3	7.8	1.93 – 2.03	110.0 – 120.0	26.6	65.5
98	79 – 82	445.5 – 460.8	431.6 – 446.6	7.9	1.93 – 2.03	109.0 – 119.0	26.9	65.5
99	79 – 82	451.0 – 466.6	436.7 – 451.9	8.1	1.93 – 2.03	109.0 – 119.0	27.3	65.6
100	79 – 82	456.5 – 472.3	441.8 – 457.1	8.3	1.93 – 2.03	109.0 – 119.0	27.6	65.6
101	78 – 81	462.0 – 478.0	446.8 – 462.3	8.5	1.93 – 2.03	108.0 – 118.0	27.9	65.6
102	78 – 81	467.4 – 483.7	451.7 – 467.5	8.7	1.94 – 2.03	108.0 – 118.0	28.3	65.6
103	78 – 81	472.9 – 489.3	456.7 – 472.7	8.9	1.94 – 2.03	107.0 – 117.0	28.6	65.6
104	77 – 80	478.3 – 494.9	461.6 – 477.7	9.1	1.94 – 2.03	107.0 – 117.0	28.9	65.7
105	77 – 80	483.7 – 500.5	466.5 – 482.8	9.3	1.94 – 2.03	106.0 – 116.0	29.2	65.7
106	77 – 80	489.1 – 506.1	471.4 – 487.9	9.5	1.94 – 2.03	106.0 – 116.0	29.6	65.7
107	76 – 79	494.4 – 511.7	476.2 – 492.9	9.7	1.94 – 2.04	105.0 – 115.0	29.9	65.7
108	76 – 79	499.7 – 517.2	481.0 – 497.9	9.9	1.95 – 2.05	105.0 – 115.0	30.2	65.7
109	76 – 79	505.0 – 522.7	485.5 – 502.8	10.1	1.95 – 2.05	104.0 – 114.0	30.5	65.7
110	76 – 79	510.3 – 528.3	490.5 – 507.8	10.4	1.95 – 2.05	104.0 – 114.0	30.8	65.7

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

Post-Molt Performance Standards Graph

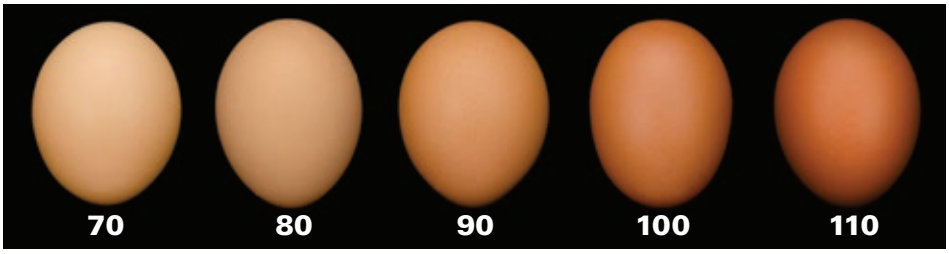


Egg Quality and Egg Size Standards

EGG QUALITY			
AGE (weeks)	HAUGH UNITS	BREAKING STRENGTH	SHELL COLOR
20	97.8	4605	89
22	97.0	4590	89
24	96.0	4580	89
26	95.1	4570	88
28	94.2	4560	88
30	93.3	4540	88
32	92.2	4515	88
34	91.5	4490	88
36	90.6	4450	87
38	90.0	4425	87
40	89.3	4405	87
42	88.5	4375	87
44	87.8	4355	87
46	87.1	4320	87
48	86.4	4305	87
50	85.6	4280	86
52	85.0	4250	86
54	84.6	4225	86
56	84.0	4190	85
58	83.1	4170	85
60	82.6	4150	85
62	82.2	4130	84
64	81.9	4110	83
66	81.6	4095	83
68	81.5	4085	82
70	81.1	4075	81
72	81.0	4065	81
74	80.8	4055	80
76	80.5	4040	80
78	80.2	4020	80
80	80.1	3995	80
82	80.0	3985	79
84	79.9	3975	79
86	79.8	3965	79
88	79.7	3960	79
90	79.7	3955	79

EGG SIZE DISTRIBUTION—E.U.STANDARDS					
AGE (weeks)	AVERAGE EGG WEIGHT (g)	% VERY LARGE Over 73 g	% LARGE 63–73 g	% MEDIUM 53–63 g	% SMALL 43–53 g
20	51.2	0.0	0.0	21.7	78.3
22	54.2	0.0	0.0	69.9	30.1
24	56.6	0.0	0.3	93.9	5.9
26	58.5	0.0	2.5	96.6	0.8
28	60.2	0.0	11.2	88.7	0.1
30	60.9	0.0	18.1	81.9	0.0
32	61.3	0.0	23.9	76.0	0.0
34	61.7	0.0	29.4	70.6	0.0
36	61.9	0.0	32.3	67.7	0.0
38	62.1	0.0	35.9	64.0	0.0
40	62.3	0.0	39.0	61.0	0.0
42	62.6	0.0	43.9	56.1	0.0
44	62.9	0.0	48.5	51.5	0.0
46	63.0	0.0	50.0	50.0	0.0
48	63.2	0.0	52.8	47.1	0.0
50	63.4	0.0	55.5	44.5	0.0
52	63.5	0.1	56.5	43.5	0.0
54	63.5	0.1	56.5	43.4	0.0
56	63.6	0.1	57.3	42.6	0.0
58	63.6	0.2	57.3	42.5	0.0
60	63.7	0.3	58.2	41.5	0.0
62	63.8	0.4	59.0	40.6	0.0
64	63.9	0.6	59.7	39.8	0.0
66	64.0	0.9	60.3	38.9	0.0
68	64.1	1.1	60.4	38.4	0.0
70	64.2	1.6	60.4	38.0	0.0
72	64.3	1.9	60.8	37.3	0.0
74	64.4	2.6	60.7	36.7	0.0
76	64.5	3.1	60.7	36.2	0.0
78	64.6	4.0	60.4	35.6	0.0
80	64.8	5.1	59.9	35.1	0.0
82	64.8	5.9	59.1	34.9	0.0
84	64.9	6.9	58.3	34.8	0.0
86	64.9	8.1	57.1	34.8	0.0
88	65.0	9.2	56.3	34.4	0.0
90	65.0	10.3	55.2	34.4	0.0

SHELL COLOR SCORES

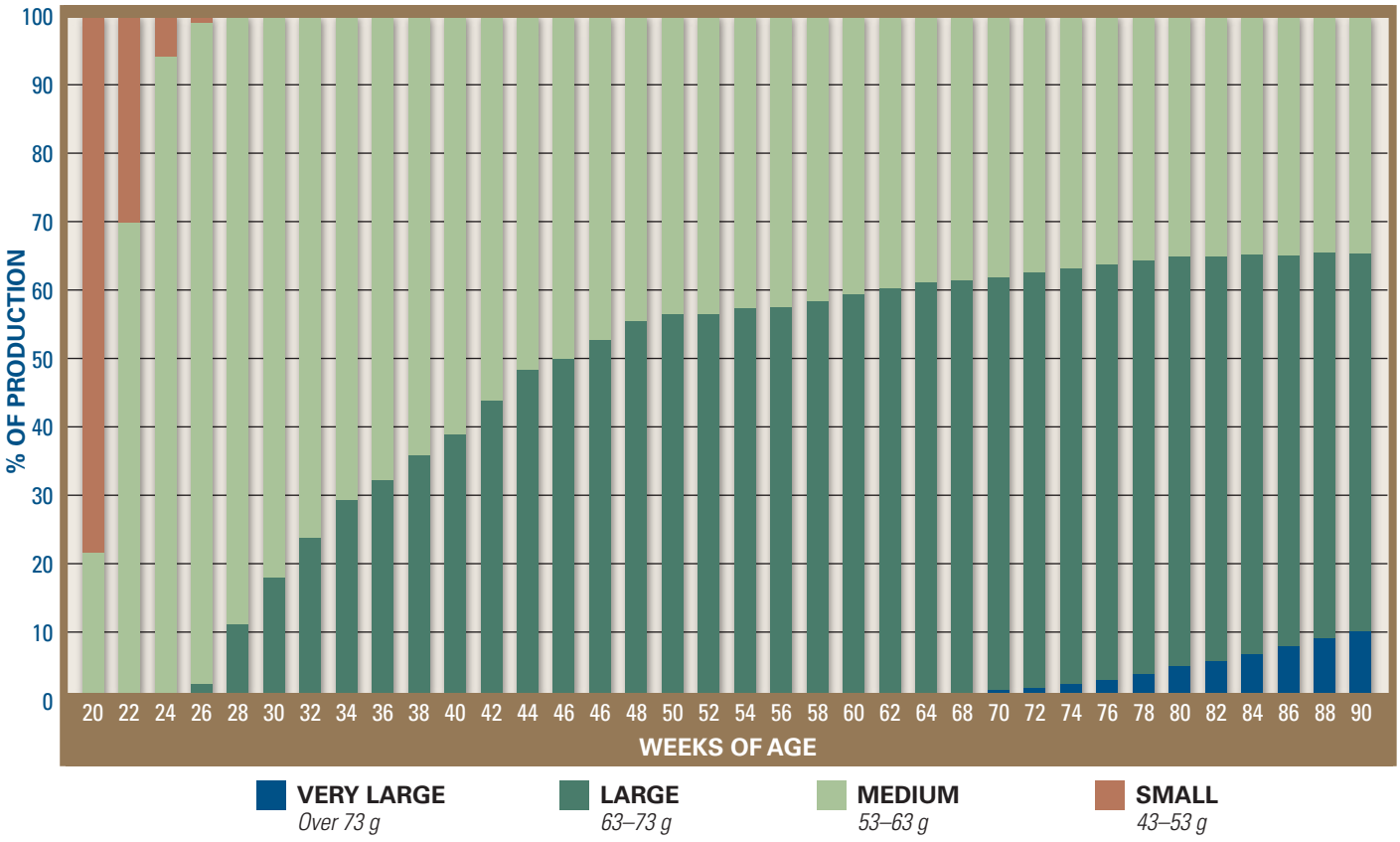


Egg Size Standards *(continued)*

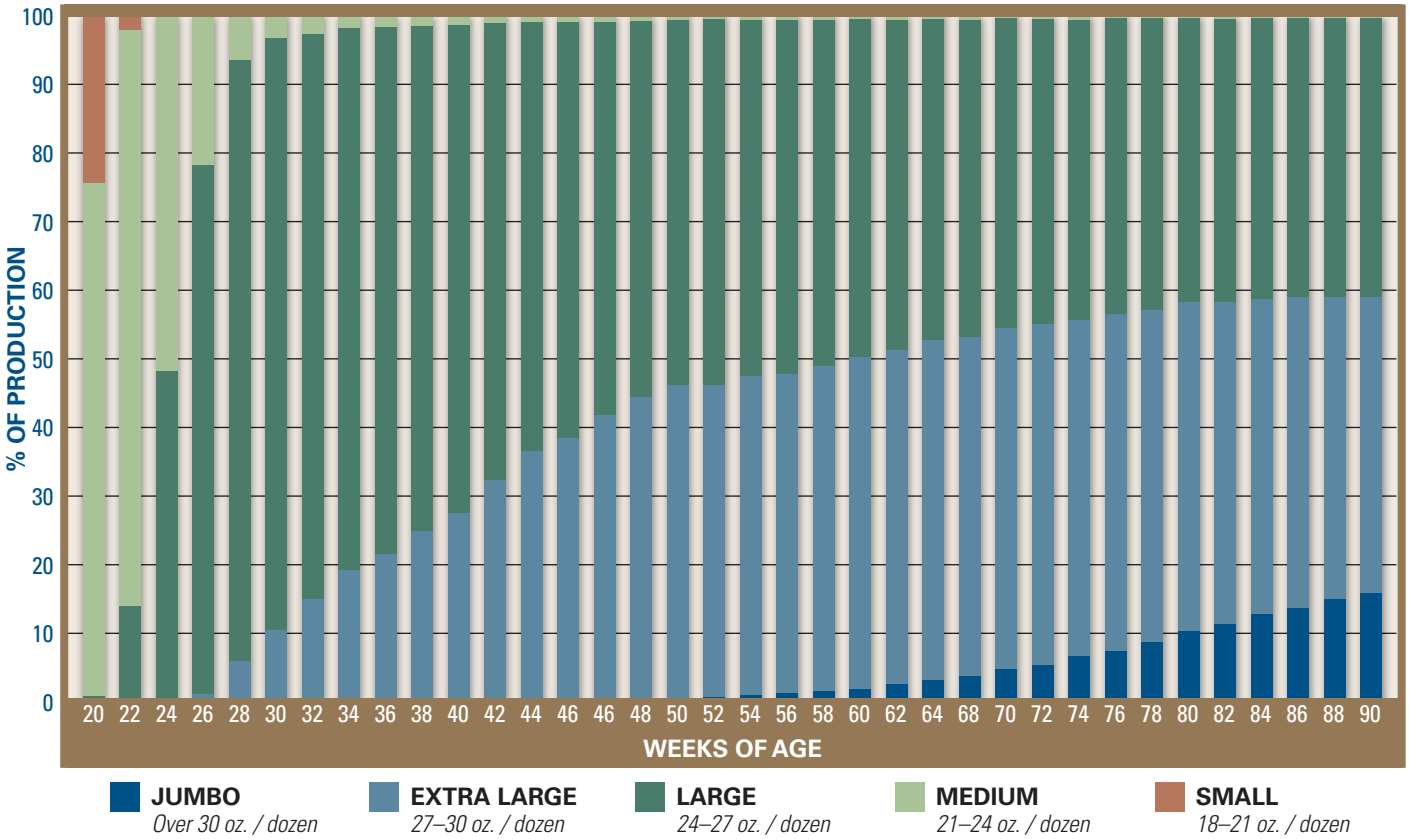
EGG SIZE DISTRIBUTION—U.S.STANDARDS						
AGE (weeks)	AVERAGE EGG WEIGHT (lbs. / case)	% JUMBO Over 30 oz. / dozen	% EXTRA LARGE 27–30 oz. / dozen	% LARGE 24–27 oz. / dozen	% MEDIUM 21–24 oz. / dozen	% SMALL 18–21 oz. / dozen
20	40.63	0.0	0.0	0.8	74.8	24.3
22	43.02	0.0	0.0	14.0	83.8	2.3
24	44.92	0.0	0.1	48.2	51.6	0.1
26	46.43	0.0	1.1	77.2	21.7	0.0
28	47.78	0.0	5.9	87.7	6.4	0.0
30	48.33	0.0	10.5	86.2	3.4	0.0
32	48.65	0.0	15.0	82.3	2.8	0.0
34	48.97	0.0	19.2	79.0	1.9	0.0
36	49.13	0.0	21.5	76.9	1.5	0.0
38	49.29	0.0	24.9	73.6	1.4	0.0
40	49.44	0.0	27.5	71.2	1.3	0.0
42	49.68	0.1	32.3	66.5	1.2	0.0
44	49.92	0.1	36.5	62.5	1.0	0.0
46	50.00	0.2	38.3	60.5	1.0	0.0
48	50.16	0.3	41.4	57.4	0.9	0.0
50	50.32	0.4	44.1	54.7	0.8	0.0
52	50.40	0.6	45.5	53.3	0.7	0.0
54	50.40	0.7	45.5	53.2	0.7	0.0
56	50.48	0.9	46.5	51.9	0.7	0.0
58	50.48	1.2	46.5	51.7	0.7	0.0
60	50.56	1.5	47.5	50.4	0.6	0.0
62	50.63	1.9	48.3	49.3	0.6	0.0
64	50.71	2.6	48.6	48.2	0.6	0.0
66	50.79	3.2	49.5	46.8	0.6	0.0
68	50.87	3.7	49.5	46.1	0.6	0.0
70	50.95	4.8	49.6	45.2	0.5	0.0
72	51.03	5.4	49.6	44.5	0.5	0.0
74	51.11	6.6	49.1	43.7	0.5	0.0
76	51.19	7.4	49.1	43.1	0.5	0.0
78	51.27	8.7	48.4	42.6	0.4	0.0
80	51.43	10.3	48.0	41.3	0.4	0.0
82	51.43	11.3	47.0	41.2	0.4	0.0
84	51.51	12.7	46.0	40.9	0.4	0.0
86	51.51	13.7	45.2	40.8	0.3	0.0
88	51.59	15.0	44.0	40.7	0.3	0.0
90	51.59	15.9	43.1	40.6	0.3	0.0

Egg Size Standards Graphs

EGG SIZE DISTRIBUTION—E.U.STANDARDS



EGG SIZE DISTRIBUTION—U.S.STANDARDS



Feed Ingredient Table 1

INGREDIENT (as-fed basis)	DRY MATTER (%)	CRUDE PROTEIN (%)	FAT–ether extract (%)	CRUDE FIBER (%)	CALCIUM (%)	PHOSPHORUS total (%)	PHOSPHORUS available (%)	SODIUM (%)	CHLORIDE (%)	POTASSIUM (%)	SULFUR (%)	ME (kcal/lb)	ME (kcal/kg)	ME (MJ/kg)	LINOLEIC ACID (%)	CHOLINE (mg/kg)
Barley, grain	89.0	11.5	1.9	5.0	0.08	0.42	0.15	0.03	0.14	0.56	0.15	1250	2750	11.51	1.1	1027
Beans, broad (vicia faba)	89.0	25.7	1.4	8.2	0.14	0.54	0.20	0.08	0.04	1.20	–	1100	2420	10.13	0.9	1670
Calcium carbonate (38%Ca)	99.5	–	–	–	38.00	–	–	0.06	–	0.06	–	–	–	–	–	–
Canola meal (38%)	91.0	38.0	3.8	11.1	0.68	1.20	0.40	–	–	1.29	1.00	960	2110	8.83	0.6	6700
Canola oil	99.0	–	99.0	–	–	–	–	–	–	–	–	4000	8820	36.92	20.50	–
Corn, yellow, grain	86.0	7.5	3.5	1.9	0.01	0.28	0.12	0.02	0.04	0.33	0.08	1530	3373	14.12	1.9	1100
Corn gluten feed	88.0	21.0	2.0	10.0	0.20	0.90	0.22	0.15	0.22	1.30	0.16	795	1750	7.32	1.6	2420
Corn gluten meal (60%)	90.0	60.0	2.0	2.5	0.02	0.50	0.18	0.03	0.05	0.45	0.50	1700	3740	15.65	1.8	2200
Distillers dried grains, corn	92.0	27.0	9.0	13.0	0.09	0.41	0.17	0.25	0.07	0.16	0.43	910	2000	8.37	5.05	1850
Cottonseed meal (41%), mech. Extd	91.0	41.0	3.9	12.6	0.17	0.97	0.32	0.04	0.04	1.20	0.40	955	2100	8.79	0.8	2807
Cottonseed meal (41%), direct solv.	90.0	41.0	2.1	11.3	0.16	1.00	0.32	0.04	0.04	1.16	0.30	915	2010	8.41	0.4	2706
Dicalcium phosphate (18.5% P)	99.5	–	–	–	22.00	18.50	18.50	0.08	–	0.07	–	–	–	–	–	–
DL-Methionine	99.5	58.1	–	–	–	–	–	–	–	–	–	2277	5020	21.01	–	–
Fat, animal	99.0	–	98.0	–	–	–	–	–	–	–	–	3600	7920	33.15	–	–
Fat, animal-vegetable blend	98.0	–	92.0	–	–	–	–	–	–	–	–	3800	8379	35.07	30.00	–
Fat, vegetable	99.0	–	99.0	–	–	–	–	–	–	–	–	4000	8800	36.83	40.00	–
Fish meal, anchovy, Peruvian	91.0	65.0	10.0	1.0	4.00	2.85	2.85	0.88	0.60	0.90	0.54	1280	2820	11.80	0.1	5100
Fish meal, white	91.0	61.0	4.0	1.0	7.00	3.50	3.50	0.97	0.50	1.10	0.22	1180	2600	10.88	0.1	4050
Flaxseed	92.0	22.0	34.0	6.5	0.25	0.50	–	0.08	–	1.50	–	1795	3957	16.56	54.00	3150
Linseed meal flax (expeller)	90.0	32.0	3.5	9.5	0.40	0.80	–	0.11	–	1.24	0.39	700	1540	6.45	0.5	1672
Linseed meal flax (solvent)	88.0	33.0	0.5	9.5	0.35	0.75	–	0.14	–	1.38	0.39	635	1400	5.86	0.1	1760
L-Lysine·HCl	99.5	93.4	–	–	–	–	–	–	–	–	–	1868	4120	17.24	–	–
L-Threonine	99.5	72.4	–	–	–	–	–	–	–	–	–	1619	3570	14.94	–	–
L-Tryptophan	95.0	84.0	–	–	–	–	–	–	–	–	–	2653	5850	24.49	–	–
Meat and bone meal, 50%	93.0	50.0	8.5	2.8	9.20	4.70	4.70	0.80	0.75	1.40	0.40	1150	2530	10.59	0.5	2000
Mono-dicalcium phosphate (21% P)	99.5	–	–	–	16.00	21.00	–	0.05	–	0.06	–	–	–	–	–	–
Oats, grain	90.0	11.0	4.0	10.5	0.10	0.35	0.14	0.07	0.12	0.37	0.21	1160	2550	10.67	2.4	1070
Peanut meal, solvent	90.0	47.0	2.5	8.4	0.08	0.57	0.18	0.07	0.03	1.22	0.30	1217	2677	11.20	0.5	1948
Poultry byproduct meal (feed grade)	94.0	57.0	14.0	2.5	5.00	2.70	2.70	0.30	0.55	0.60	0.50	1406	3100	12.98	0.7	5980
Rice bran, unextracted	91.0	13.5	5.9	13.0	0.10	1.70	0.24	0.10	0.07	1.35	0.18	925	2040	8.54	5.2	1390
Rice, grain, rough	89.0	7.3	1.7	10.0	0.04	0.26	0.09	0.04	0.06	0.34	0.10	1335	2940	12.31	0.83	1014
Safflower seed meal, expeller	91.0	20.0	6.6	32.2	0.23	0.61	0.20	0.05	0.16	0.72	0.10	525	1160	4.86	–	800
Salt, NaCl	99.6	–	–	–	–	–	–	39.34	60.66	–	–	–	–	–	–	–
Sodium bicarbonate, $NaHCO_3$	99.0	–	–	–	–	–	–	27.38	–	–	–	–	–	–	–	–
Sorghum, milo, grain	89.0	11.0	2.8	2.0	0.04	0.29	0.10	0.03	0.09	0.34	0.09	1505	3310	13.85	1.3	678
Soybeans, full-fat, cooked	90.0	38.0	18.0	5.0	0.25	0.59	0.20	0.04	0.03	1.70	0.30	1520	3350	14.02	9.9	2420
Soybean meal, expeller	89.0	42.0	3.5	6.5	0.20	0.60	0.20	0.04	0.02	1.71	0.33	1100	2420	10.13	1.8	2673
Soybean meal, solvent	90.0	44.0	0.5	7.0	0.25	0.60	0.20	0.04	0.02	1.97	0.43	1020	2240	9.38	0.3	2743
Soybean meal dehulled, solvent	88.0	47.8	1.0	3.0	0.31	0.72	0.24	0.04	0.02	2.05	0.43	1115	2458	10.29	0.6	2850
Soybean oil	99.0	–	99.0	–	–	–	–	–	–	–	–	4000	8820	36.92	40.00	–
Sunflower meal, expeller	93.0	41.0	7.6	21.0	0.43	1.00	0.25	0.20	0.01	1.00	–	1050	2310	9.67	6.5	–
Sunflower meal, partially dehul, solv.	92.0	34.0	0.5	13.0	0.30	1.25	0.27	0.20	0.01	1.60	0.38	1025	2260	9.46	0.2	1909
Triticale	90.0	12.5	1.5	–	0.05	0.30	0.10	–	0.07	–	0.20	1430	3150	13.18	0.9	460
Wheat, hard grain	88.0	13.5	1.9	3.0	0.05	0.41	0.12	0.06	0.07	0.50	0.10	1440	3170	13.27	1.0	778
Wheat, soft grain	86.0	10.8	1.7	2.8	0.05	0.30	0.11	0.06	0.07	0.40	0.10	1460	3210	13.44	1.0	778
Wheat bran	89.0	14.8	4.0	10.0	0.14	1.17	0.38	0.06	0.14	1.20	0.22	590	1300	5.44	2.1	980
Wheat middlings	89.0	15.0	3.6	8.5	0.15	1.17	0.45	0.06	0.07	0.60	0.16	950	2090	8.75	1.9	1100

Nutrient recommendations are based on calculations using these energy and nutrient values (source: 2014 Feedstuffs Reference Issue and field data). Values provided are "typical" based on ingredient surveys. Nutrient values should be confirmed by analysis of the materials being used in order to maintain an accurate formulation matrix

Feed Ingredient Table 2

INGREDIENT (as-fed basis)	CRUDE PROTEIN (%)	LYSINE (%)		METHIONINE (%)		CYSTINE (%)		THREONINE (%)		TRYPTOPHAN (%)		ARGININE (%)		ISOLEUCINE (%)		VALINE (%)	
		Total content	Digestible content	Total content	Digestible content	Total content	Digestible content	Total content	Digestible content	Total content	Digestible content	Total content	Digestible content	Total content	Digestible content	Total content	Digestible content
Barley	11.5	0.40	0.35	0.18	0.16	0.24	0.21	0.38	0.32	0.14	0.10	0.56	0.48	0.39	0.35	0.55	0.46
Beans, Field	25.7	1.61	1.37	0.18	0.13	0.30	0.20	0.88	0.69	0.22	0.15	2.27	1.97	1.02	0.74	1.15	0.83
Corn	7.5	0.23	0.21	0.16	0.15	0.17	0.15	0.27	0.23	0.06	0.05	0.36	0.34	0.25	0.24	0.35	0.32
Corn Gluten Feed	21.0	0.65	0.47	0.34	0.29	0.44	0.29	0.75	0.57	0.10	0.09	0.96	0.85	0.62	0.51	0.99	0.83
Corn Gluten Meal	60.0	0.99	0.75	1.43	1.26	1.03	0.80	2.00	1.58	0.32	0.21	1.88	1.62	2.39	2.05	2.71	2.30
Dist Dried Grains & Sol, Corn	27.0	0.76	0.57	0.53	0.43	0.50	0.38	1.01	0.72	0.22	0.17	1.16	0.85	0.99	0.83	1.31	1.06
Cottonseed Meal	41.0	1.63	1.06	0.58	0.42	0.65	0.48	1.27	0.86	0.51	0.40	4.67	4.11	1.25	0.89	1.75	1.29
DL-Methionine	58.1	–	–	99.00	99.00	–	–	–	–	–	–	–	–	–	–	–	–
Fish Meal (65%)	65.0	4.67	4.02	1.72	1.48	0.54	0.39	2.61	2.08	0.66	0.52	3.71	3.04	2.60	2.21	3.05	2.53
Fish Meal (61%)	61.0	4.24	3.65	1.57	1.35	0.50	0.36	2.39	1.92	0.60	0.47	3.45	2.83	2.39	2.03	2.82	2.34
Linseed Products	22.0	0.92	0.83	0.39	0.31	0.37	0.29	0.80	0.73	0.33	0.30	1.99	1.83	0.90	0.79	1.07	0.92
L-Lysine·HCl	93.4	78.80	78.80	–	–	–	–	–	–	–	–	–	–	–	–	–	–
L-Threonine	72.4	–	–	–	–	–	–	98.50	98.50	–	–	–	–	–	–	–	–
L-Tryptophan	84.0	–	–	–	–	–	–	–	–	98.00	98.00	–	–	–	–	–	–
Meat And Bone Meal	50.0	2.33	1.61	0.65	0.46	0.41	0.20	1.53	0.95	0.29	0.15	3.45	2.66	1.36	0.94	2.02	1.42
Oats	11.0	0.44	0.39	0.18	0.15	0.31	0.26	0.37	0.31	0.15	0.12	0.72	0.67	0.40	0.35	0.54	0.48
Peanut Meal	47.0	1.50	1.14	0.49	0.42	0.59	0.47	1.20	1.02	0.46	0.40	5.19	4.72	1.50	1.34	1.82	1.62
Poultry Byproduct Meal	57.0	3.40	2.72	1.10	0.92	0.72	0.49	2.21	1.70	0.55	0.43	3.78	3.17	2.17	1.74	2.70	2.13
Rapeseed Meal	38.0	1.95	1.56	0.73	0.61	0.92	0.71	1.55	1.13	0.52	0.41	2.32	2.02	1.46	1.15	1.86	1.47
Rice	7.3	0.26	0.21	0.19	0.17	0.17	0.14	0.25	0.20	0.09	0.08	0.57	0.52	0.28	0.23	0.40	0.34
Rice Bran	13.5	0.61	0.45	0.26	0.20	0.27	0.19	0.50	0.34	0.17	0.13	1.05	0.90	0.46	0.35	0.71	0.53
Safflower Meal	20.0	0.59	0.49	0.30	0.26	0.32	0.25	0.62	0.45	0.19	0.15	1.66	1.40	0.70	0.56	1.00	0.81
Sorghum	11.0	0.25	0.23	0.19	0.17	0.19	0.15	0.35	0.29	0.12	0.11	0.41	0.36	0.43	0.38	0.53	0.47
Soybean Expeller	42.0	2.50	2.25	0.58	0.52	0.62	0.51	1.64	1.39	0.52	0.50	2.94	2.73	1.88	1.67	1.99	1.75
Soybean Meal (44%)	44.0	2.71	2.44	0.59	0.54	0.63	0.52	1.73	1.47	0.60	0.54	3.20	2.98	1.99	1.77	2.09	1.84
Soybean Meal (47.8%)	47.8	2.91	2.62	0.64	0.58	0.68	0.56	1.86	1.58	0.64	0.57	3.49	3.24	2.17	1.93	2.26	1.99
Soybean, full-fat	38.0	2.40	2.09	0.54	0.48	0.55	0.43	1.69	1.39	0.52	0.45	2.80	2.52	2.18	1.87	2.02	1.72
Sunflower Meal (34%)	34.0	1.17	1.02	0.74	0.68	0.55	0.44	1.22	1.00	0.45	0.39	2.75	2.56	1.37	1.22	1.65	1.43
Sunflower Meal (41%)	41.0	1.37	1.19	0.88	0.81	0.66	0.53	1.45	1.19	0.54	0.47	3.42	3.18	1.66	1.48	1.99	1.73
Triticale	12.5	0.38	0.33	0.20	0.18	0.27	0.23	0.38	0.33	0.13	0.11	0.61	0.50	0.41	0.38	0.54	0.47
Wheat (13.5%)	13.5	0.36	0.31	0.20	0.19	0.29	0.26	0.38	0.33	0.16	0.14	0.64	0.54	0.45	0.37	0.56	0.50
Wheat (10.8%)	10.8	0.31	0.27	0.17	0.15	0.25	0.22	0.31	0.27	0.14	0.12	0.52	0.44	0.36	0.29	0.46	0.41
Wheat Bran	14.8	0.60	0.43	0.22	0.17	0.30	0.22	0.48	0.35	0.24	0.19	1.00	0.82	0.46	0.36	0.67	0.52
Wheat Middlings	15.0	0.60	0.48	0.23	0.19	0.30	0.22	0.48	0.35	0.21	0.17	1.00	0.80	0.47	0.39	0.69	0.53

Amino acid digestibility is standardized ileal digestibility. Amino acid values are standardized for 88% dry matter (Source: Evonik AminoDAT® 4.0, 2010). Values provided are "typical" based on ingredient surveys. Nutrient values should be confirmed by analysis of the materials being used in order to maintain an accurate formulation matrix

Hy-Line International Welfare Goals and Principles

To promote animal well-being and produce birds of the highest quality, we adhere to the following welfare goals and principles. These goals and principles are the essential building blocks for the humane and professional care of our birds:

- **Feed and Water**
  Provide access to good quality water and nutritionally balanced diets at all times
- **Health and Veterinary Care**
  Provide science-based health programs and prompt veterinary care
- **Environment**
  Provide shelter that is designed, maintained and operated to meet the bird's needs and to facilitate daily inspection
- **Husbandry and Handling Practices**
  Provide comprehensive care and handling procedures that ensure the bird's well-being throughout its life
- **Transportation**
  Provide transportation that minimizes travel time and stress

RESOURCES

Hy-Line International www.hyline.com

Hy-Line Red Book, *an Online Management Guide* www.hylineredbook.com

Hy-Line International Lighting Program www.hylineweblighting.com

Hy-Line EggCel www.hylineeggcel.com

Hy-Line Bodyweight Uniformity Calculator www.hylinebodyweight.com

TECHNICAL UPDATES

Growing Management of Commercial Pullets www.hylinepullet.com

Understanding the Role of the Skeleton in Egg Production www.hylineskeleton.com

The Science of Egg Quality www.hylineeggquality.com

An Overview of Focal Duodenal Necrosis www.hylinefdn.com

MG Control in Commercial Layers www.hylinemgcontrol.com

PRODUCT UPDATE

Hy-Line Brown – Selecting for Superior Egg Quality www.hylinebrowneggquality.com

Hy-Line®

Hy-Line International | www.hyline.com

Hy-Line is a brand name. ®Registered Trademark of Hy-Line International. ©Copyright 2014 Hy-Line International. M.COM.BR.E.01-14.A4