Hy-Line

BROWN COMMERCIAL LAYERS

2016

Management Guide

Hy-Line®

BROWN

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 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.

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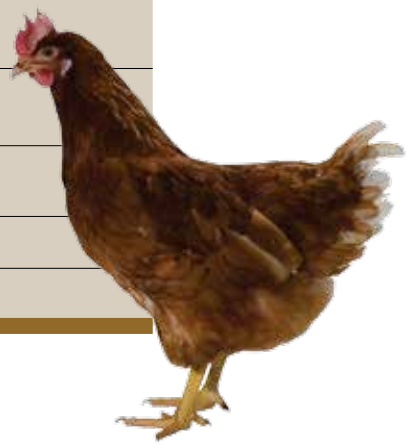
Summary of Performance Standards

REARING 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 Hen-Day Eggs to 110 Weeks	257–266 419–432 510–528
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 Egg Weight at 110 Weeks	57.3–59.7 g / egg 60.1–62.5 g / egg 62.9–65.5 g / egg 65.7 g / egg
Total Egg Mass per Hen-Housed (18–90 weeks)	25.5 kg
Body Weight at 32 Weeks Body Weight at 70 Weeks Body Weight at 110 Weeks	1.85–1.97 kg 1.91–2.03 kg 1.95–2.05 kg
Freedom From Egg Inclusions	Excellent
Shell Strength	Excellent
Shell Color at 38 Weeks Shell Color at 56 Weeks Shell Color at 70 Weeks Shell Color at 90 Weeks	87 85 81 79
Haugh Units at 38 Weeks Haugh Units at 56 Weeks Haugh Units at 70 Weeks Haugh Units at 90 Weeks	90.0 84.0 81.1 79.7
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 Consumption per 10 Eggs (20–60 weeks) Feed Consumption per 10 Eggs (20–90 weeks)	1.18–1.22 kg 1.26–1.29 kg
Feed Consumption per Dozen Eggs (20–60 weeks) Feed Consumption 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.*

Performance Tables

Rearing Period

AGE (weeks)	MORTALITY Cumulative (%)	BODY WEIGHT (kg)	FEED INTAKE (g /bird / day)	CUMULATIVE FEED INTAKE (g to date)	WATER CONS. (ml / bird / day)	UNIFORMITY (Cage)
1	0.5	0.06 – 0.07	14 – 15	98 – 105	21 – 30	>85%
2	0.7	0.12 – 0.13	17 – 21	217 – 252	26 – 42	
3	0.8	0.18 – 0.20	23 – 25	378 – 427	35 – 50	
4	0.9	0.26 – 0.27	27 – 29	567 – 630	41 – 58	>80%
5	1.0	0.35 – 0.37	34 – 36	805 – 882	51 – 72	
6	1.1	0.45 – 0.47	38 – 40	1071 – 1162	57 – 80	
7	1.2	0.54 – 0.58	41 – 43	1358 – 1463	62 – 86	>85%
8	1.2	0.65 – 0.69	45 – 47	1673 – 1792	68 – 94	
9	1.3	0.76 – 0.80	49 – 53	2016 – 2163	74 – 106	
10	1.3	0.86 – 0.92	52 – 56	2380 – 2555	78 – 112	
11	1.4	0.96 – 1.02	58 – 62	2786 – 2989	87 – 124	
12	1.5	1.05 – 1.11	62 – 66	3220 – 3451	93 – 132	
13	1.6	1.13 – 1.20	67 – 71	3689 – 3948	101 – 142	>85%
14	1.7	1.19 – 1.27	70 – 74	4179 – 4466	105 – 148	
15	1.8	1.26 – 1.34	72 – 76	4683 – 4998	108 – 152	
16	1.9	1.33 – 1.41	75 – 79	5208 – 5551	113 – 158	
17	2.0	1.40 – 1.48	78 – 82	5754 – 6125	117 – 164	>90%

Laying Period

AGE (weeks)	% HEN-DAY Current	HEN-DAY EGGS Cumulative	HEN-HOUSED EGGS Cumulative	MORT-ALITY Cumulative (%)	BODY WEIGHT (kg)	FEED INTAKE (g / bird / day)	WATER CONSUMP-TION[1] (ml / bird / day)	HEN-HOUSED EGG MASS Cumulative (kg)	AVG. EGG WEIGHT[2] (g / egg)
18	4 – 14	0.3 – 1.0	0.3 – 1.0	0.0	1.47 – 1.57	82 – 88	123 – 176	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	128 – 182	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	137 – 194	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	143 – 202	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	149 – 210	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	155 – 218	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	158 – 222	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	159 – 224	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	161 – 226	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	161 – 226	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	161 – 226	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	161 – 226	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	161 – 226	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	162 – 228	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	162 – 228	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	162 – 228	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	162 – 228	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	162 – 228	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	162 – 228	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	162 – 228	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	162 – 228	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	162 – 228	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	162 – 228	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	162 – 228	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	162 – 228	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	162 – 228	9.1	61.5 – 64.1

[1] The chart shows an expected range of feed and water consumption at normal environmental temperatures of 21–27°C. As the environmental temperature increases above this range, water consumption may increase up to double the amounts shown.

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

Performance Tables *(continued)*

AGE (weeks)	% HEN-DAY Current	HEN-DAY EGGS Cumulative	HEN-HOUSED EGGS Cumulative	MORT-ALITY Cumulative (%)	BODY WEIGHT (kg)	FEED INTAKE (g / bird / day)	WATER CONSUMP-TION[1] (ml / bird / day)	HEN-HOUSED EGG MASS Cumulative (kg)	AVG. EGG WEIGHT[2] (g / egg)
44	90 – 92	159.6 – 166.5	158.1 – 165.0	1.6	1.88 – 2.00	108 – 114	162 – 228	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	161 – 226	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	161 – 226	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	161 – 226	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	161 – 226	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	161 – 226	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	161 – 226	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	159 – 224	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	159 – 224	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	159 – 224	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	159 – 224	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	159 – 224	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	159 – 224	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	159 – 224	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	159 – 224	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	159 – 224	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	159 – 224	15.5	62.4 – 65.0
61	84 – 86	262.7 – 271.7	258.9 – 267.8	2.9	1.90 – 2.02	106 – 112	159 – 224	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	159 – 224	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	159 – 224	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	159 – 224	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	159 – 224	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	159 – 224	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	159 – 224	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	159 – 224	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	159 – 224	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	159 – 224	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	159 – 224	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	159 – 224	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	159 – 224	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	159 – 224	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	159 – 224	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	159 – 224	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	159 – 224	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	159 – 224	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	159 – 224	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	159 – 224	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	159 – 224	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	159 – 224	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	159 – 224	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	159 – 224	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	159 – 224	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	159 – 224	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	159 – 224	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	159 – 224	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	159 – 224	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	159 – 224	25.5	63.7 – 66.3

[1] The chart shows an expected range of feed and water consumption at normal environmental temperatures of 21–27°C. As the environmental temperature increases above this range, water consumption may increase up to double the amounts shown.

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

Cage Brooding Recommendations

Transportation to the Farm

- Use a truck designed for transportation of chicks from hatchery to farm.
- Truck should be environmentally controlled, maintaining 26–29°C at 70% relative humidity (measured inside chick box) with a minimum air flow of 0.7 m^3 per minute.
- Provide space between stacks of chick boxes for air flow.

Chick Placement

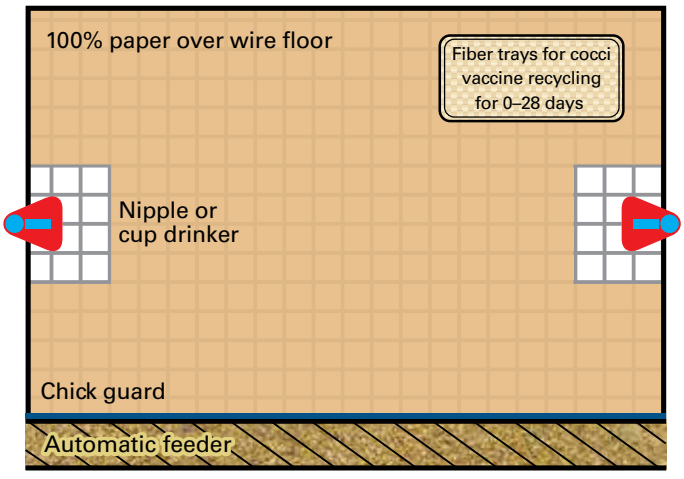
- Unload boxes quickly and gently place chicks in brooding area.
- Brood chicks in groups from similar aged breeder flocks.
- Start chicks in upper tiered cages which are usually warmer and brighter. Ensure there are no shadows on drinkers.
- Chicks from young breeder flocks should be placed in warmer and brighter areas of the house.

House Preparation before Arrival of Chicks

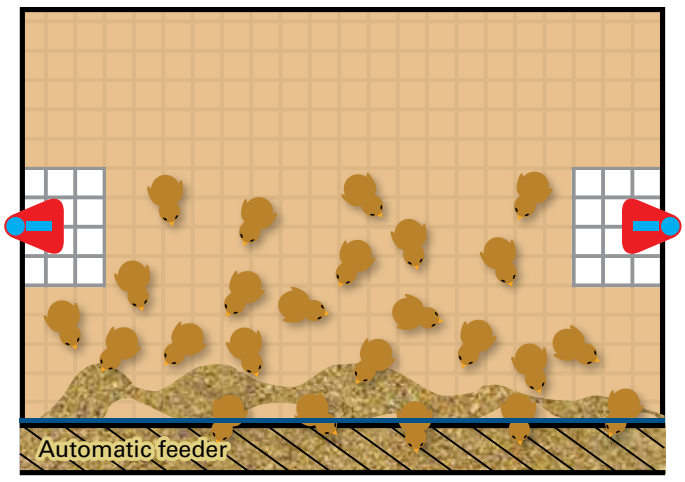
- Brooder house should be completely cleaned and disinfected well in advance of chick delivery. Confirm effectiveness of cleaning and disinfection with environmental swabs.
- Allow 2 weeks minimum downtime between flocks.
- For more information on house preparation and brooding management, see the "Growing Management of Commercial Pullets" technical update at www.hyline.com.
- Establish proper house temperature of 33–36°C (air temperature measured at chick level) and 60% humidity 24 hours before chick placement.
- Pre-heat brooding houses prior to chick placement: 24 hours in normal climates, 48 hours in cool climates and 72 hours in cold climates.
- Fill automatic feed line to its highest level and adjust chick guards. Allow access to the automatic feeder line from the first day.
- Bright light (30–50 lux) during 0–7 days helps chicks quickly find feed and water and adapt to the new environment.

Brooding Management

- Place feed on cage paper 0–3 days to encourage consumption. For beak-treated chicks, feed on paper for 0–7 days.
- Place feed in front of permanent feeder to train chicks to move toward feeders.
- Remove paper at 7–14 days of age to avoid build-up of feces.
- Find optimum balance of temperature, humidity and ventilation rate for chick comfort.
- Cage floors should not be slippery or sloped.
- Use vitamins and electrolytes in chicks' water (avoid sugar-based products to prevent growth of microorganisms).
- Chicks' body weight should double between arrival and 7 days of age.
- 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 temperatures can be used with higher relative humidity.
- For every 5 percentage point increase above 60% relative humidity, reduce brooding temperatures by 1°C.
- After the first week, reduce the temperature 2–3°C weekly until reaching 21°C.
- Do not give cold water to chicks. Be careful when flushing water lines for chicks. Allow water time to warm up in the house so chicks are comfortable drinking.

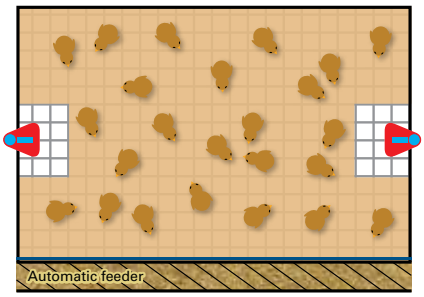


Chick guard adjusted to allow access to feeder from first day

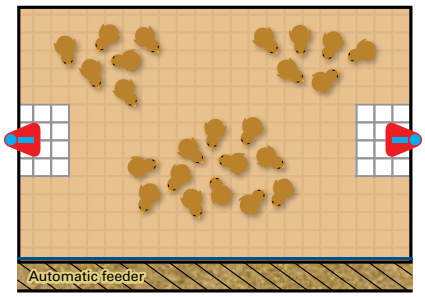


Place feed on paper near automatic feeder to train chicks

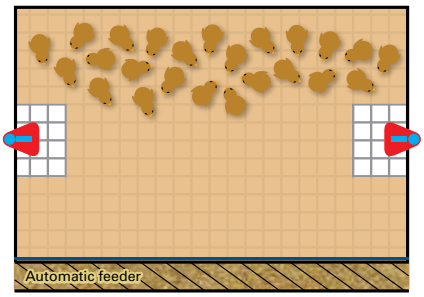
Cage Brooding Recommendations *(continued)*



CORRECT
Chicks evenly distributed in cage, active and sounding content



COLD
Chicks gathered into groups sounding distressed



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

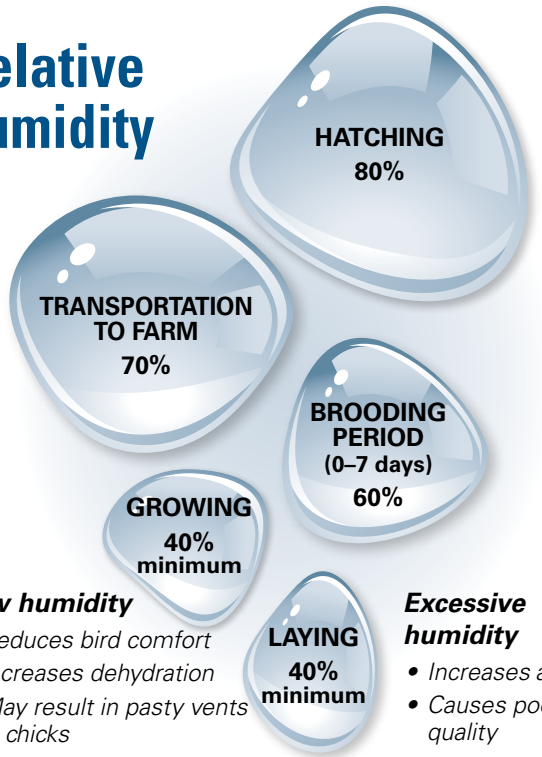






AGE	0–3 days	4–7 days	8–14 days	15–21 days	22–28 days	29–35 days	36–42 days
AIR TEMP. (CAGE)	33–36°C	30–32°C	28–30°C	26–28°C	23–26°C	21–23°C	21°C
AIR TEMP. (FLOOR)	35–36°C	33–35°C	31–33°C	29–31°C	26–27°C	23–25°C	21°C
LIGHT INTENSITY	30–50 lux	30–50 lux	25 lux	25 lux	25 lux	5–15 lux	5–15 lux
LIGHT HOURS	22 hours or Intermittent Program	21 hours or Intermittent Program	20 hours	19 hours	18 hours	17 hours	16 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

- *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

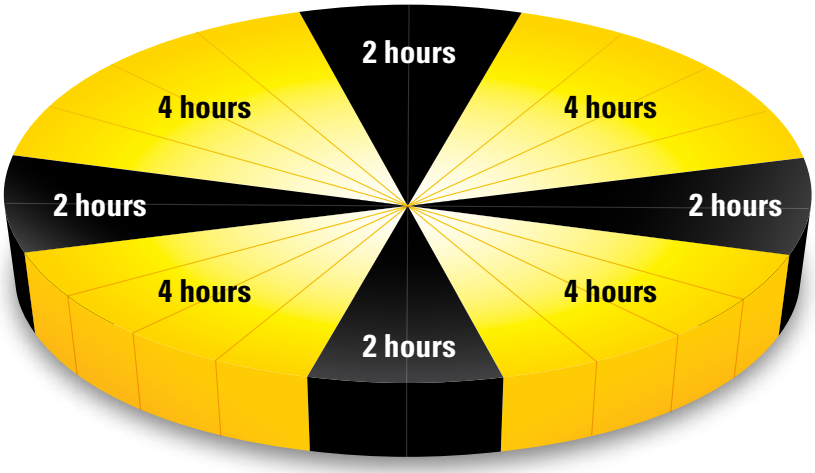

Chick without starter feed in crop

Brooding temperatures that are too low or too high will decrease the percentage of chicks with crop fill.

Lighting During Brooding Period

- An intermittent lighting program is preferred. If not using an intermittent lighting program from 0–7 days, then use 22 hours of light from 0–3 days and 21 hours of light from 4–7 days.
- 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 the new environment.
- After the first week, reduce light intensity and begin slow step-down lighting program (see Light Program for Light-Controlled Housing).

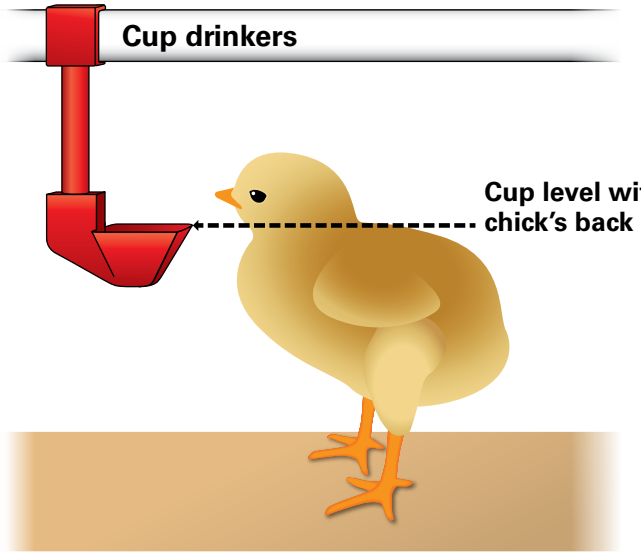
INTERMITTENT LIGHTING PROGRAM FOR CHICKS

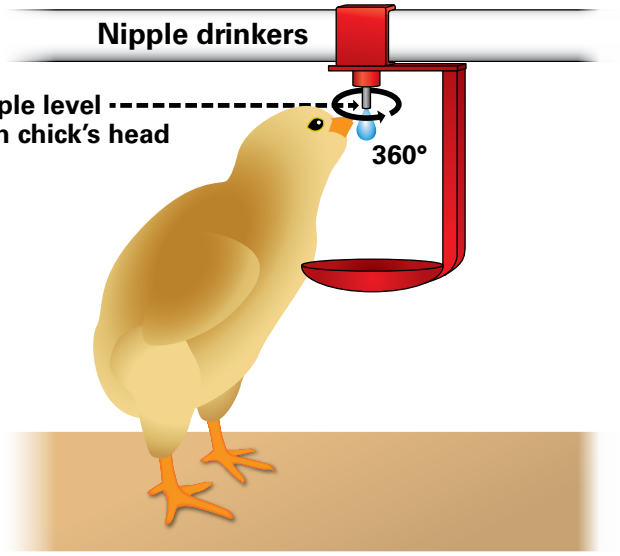


- Preferred lighting technique
- Use from 0–7 days (can be used up to 14 days of age)
- Intermittent dark periods provide rest periods for chicks
- Synchronizes chicks' activities and feedings
- Establishes more natural behavior of rest and activity
- May improve 7 day livability and pullet body weight
- May improve antibody response from vaccinations
- Some dark periods may be shortened or removed to accommodate work schedules

Drinking Systems

- The type of drinkers used during rearing should be the same as in the layer house. Also use the same nipple type in rearing and laying house (vertical vs. 360° nipples).
- Drinking water should be tested periodically for quality and cleanliness from source and end of the water line.
- Flush water lines prior to chick arrival.
- Flush water lines weekly during rearing and production periods.
- Nipple drinkers should deliver minimum 60 ml per minute / nipple, with easy activation of the drinkers by chicks.
- Record daily flock water consumption. A drop in water consumption is often the first sign of a serious problem in the flock.





- Cup drinkers should be manually filled during 0–3 days to train chicks to drink.
- Open drinkers (bell, plasson, supplemental chick drinkers, trough) are easily contaminated and should be cleaned daily.

- Adjust nipple water system pressure to create a hanging drop to help chicks find water for 0–3 days and in layer house at transfer.
- Splash cups are useful during brooding period and in hot climates.
- 360° activated nipples make drinking easy for chicks.
- Use only 360° activated nipples for hatchery beak-treated chicks.

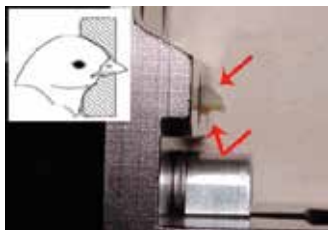
Beak Treatment / Trimming

(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 by precision beak trmming.
- If necessary, re-trim at 6 weeks or 12–14 weeks of age. A second beak trim is recommended in open-sided housing.
- In light-controlled housing, one beak trim should be sufficient.
- Hatchery beak treatment or 7–10-day beak trimming reduces feed wastage and leaves the beak less damaging to other birds.

HATCHERY INFRARED BEAK TREATMENT (IRBT)

- This provides efficient, uniform beak treatment.
- Beak remains intact until 10–21 days of age when treated portion separates.
- Use only 360° activated nipples for IRBT chicks, as well as supplemental chick drinkers.
- For IRBT chicks, feed on paper for 0–7 days.
- For more information, see the "Infrared Beak Treatment" technical update at www.hyline.com.



Infrared beak treatment can be modified according to local conditions.

Immediately following infrared beak treatment on day of hatch

7 days after infrared beak treatment

PRECISION BEAK TRIMMING

- Cauterize beak for 2 seconds at 650°C.
  - 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 a pyrometer to measure blade temperature, which should be approximately 650°C.
- Cauterizing blade color may be used as an approximate indicator of temperature.

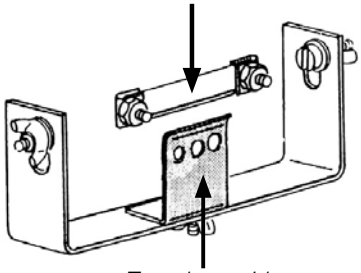
< 650°C **650°C** **> 650°C**

- Blade temperature variation of up to 40°C is common due to external influences and cannot be detected by the human eye.
- Use a 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.

Pyrometer indicating proper blade temperature of 650°C.

Properly trimmed beaks



Cauterizing blade (650°C, cherry red color)

Template with guide holes

Guide holes correspond to different size and age of chicks

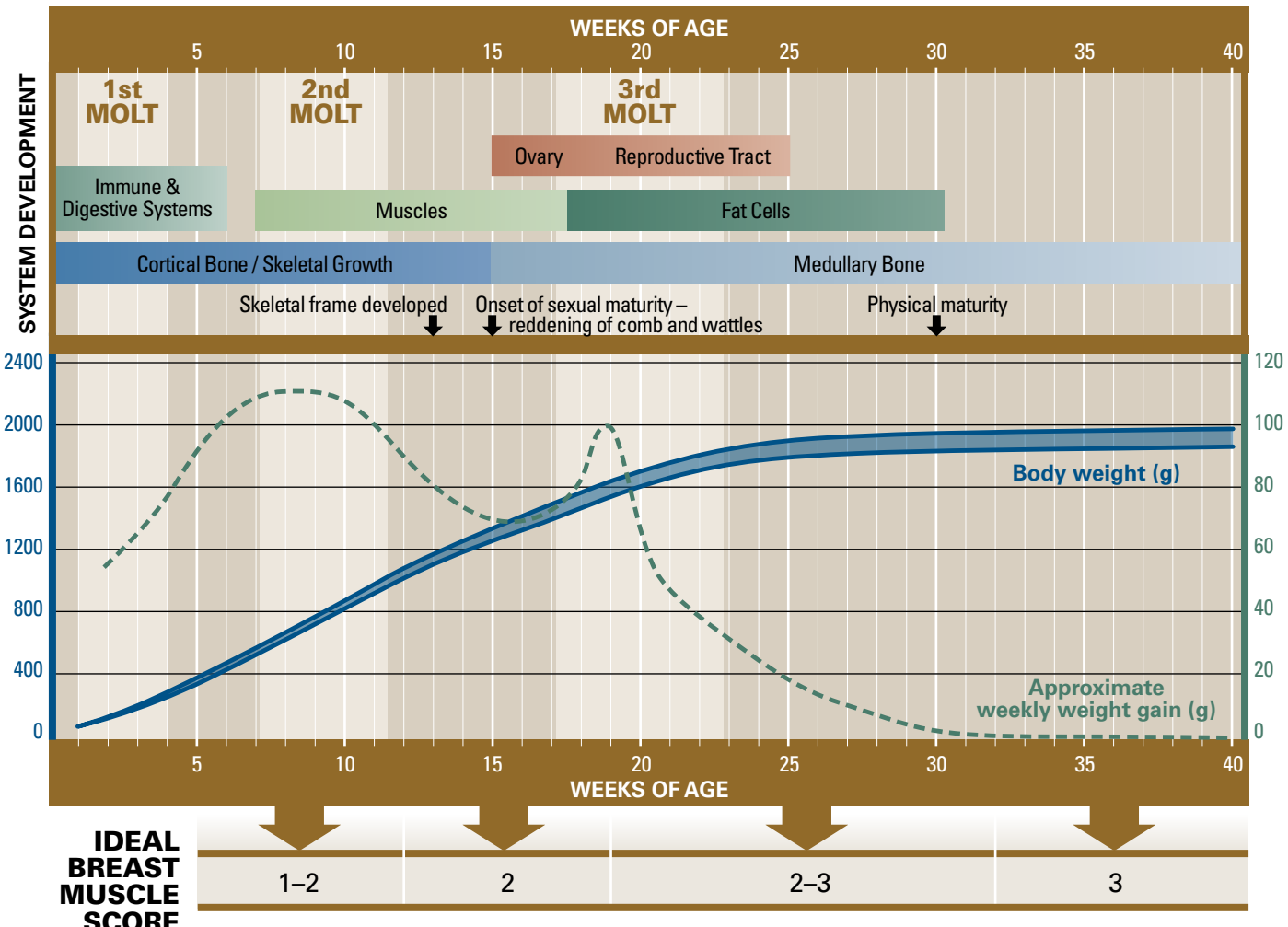
- *3.56 mm*
- *4.00 mm*
- *4.37 mm*

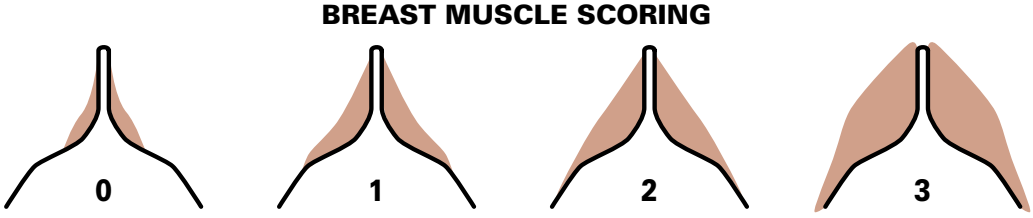
Precautions when using IRBT or beak trimming birds:

- Water intake is the most important factor in the success of IRBT/beak trimming. Chicks require immediate and easy access to water.
- Do not beak-trim sick or stressed birds.
- Do not hurry; handle chicks carefully.
- Provide vitamins and electrolytes containing vitamin K in drinking water 2 days before and 2 days after beak trimming.
- Watch chicks after beak trimming to assess stress. Raise ambient temperature until birds appear comfortable and active.
- Keep feed at the highest level for several days after beak trimming.
- Use only well-trained crews.
- Use 360° activated nipples, supplemental chick drinkers and splash cups to encourage drinking.

Growth and Development

- Focus on pullet rearing programs to optimize growth and development.
- The best predictor of future laying performance is the pullet's body weight and body type at the point of lay.
- A pullet flock entering into egg production at the correct body weight (1.40–1.48 kg) with uniformity higher than 90% performs best in the 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 the bird's body.
- If possible, exceed pullet body weight standards throughout rear.
- Change rearing diets only when recommended body weight is attained. Suggested ages are a guide if target weights are achieved.
- Delay diet change if birds are underweight or have poor diet uniformity.
- Anticipate rapid rise in ambient temperature and adjust bird's diet accordingly. Birds will eat less when exposed to a rapid temperature increase. (See the "Understanding Heat Stress in Layers" technical update at www.hyline.com.)
- Stress periods require a change in diet formulation to ensure proper nutrient intake.
- Increasing dietary fiber to 5–6% beginning with developer diet can increase crop, gizzard and intestine development and capacity.





Layers with good muscle development are better able to sustain high egg production

Rearing Body Weights, Feed Consumption and Uniformity

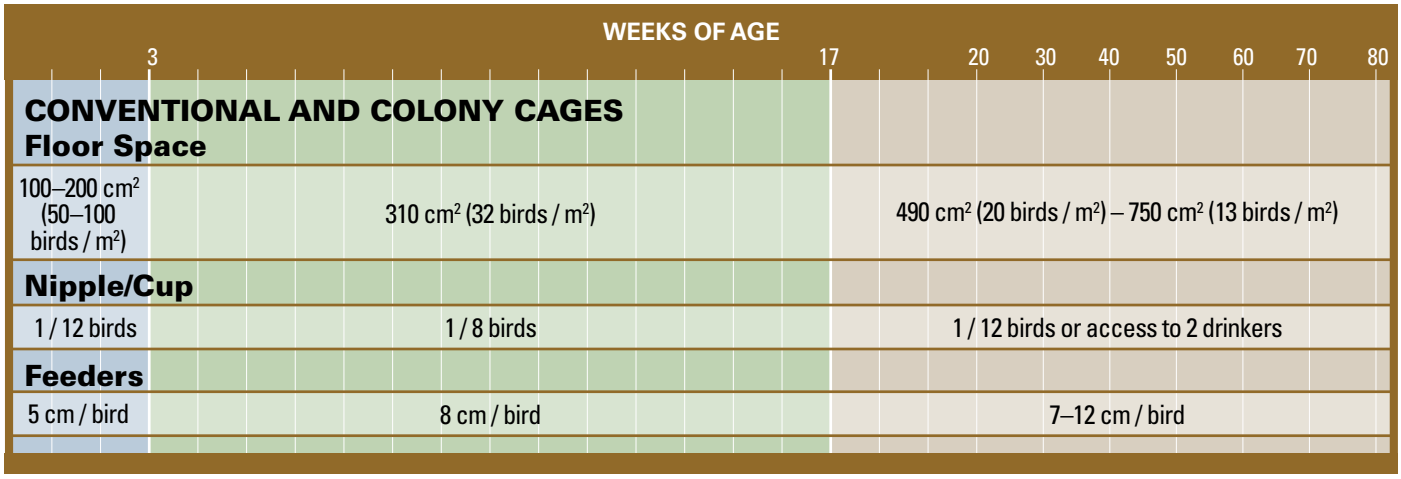
AGE (weeks)	BODY WEIGHT* (g)	FEED INTAKE (g / bird / day)	WATER CONS. (ml / bird / day)	UNIFORMITY (Cage)
1	68 – 72	14 – 15	21 – 30	>85%
2	121 – 129	17 – 21	26 – 42	
3	184 – 196	23 – 25	35 – 50	
4	257 – 273	27 – 29	41 – 58	>80%
5	349 – 371	34 – 36	51 – 72	
6	446 – 474	38 – 40	57 – 80	
7	543 – 577	41 – 43	62 – 86	>85%
8	650 – 690	45 – 47	68 – 94	
9	757 – 803	49 – 53	74 – 106	
10	863 – 917	52 – 56	78 – 112	
11	960 – 1020	58 – 62	87 – 124	
12	1048 – 1112	62 – 66	93 – 132	
13	1125 – 1195	67 – 71	101 – 142	>85%
14	1193 – 1267	70 – 74	105 – 148	
15	1261 – 1339	72 – 76	108 – 152	
16	1329 – 1411	75 – 79	113 – 158	
17	1397 – 1483	78 – 82	117 – 164	>90%

- Monitor body weights weekly from 0–30 weeks and before scheduled diet changes.
- Body weight gains and uniformity may be negatively affected by inappropriate diet changes, bird handling, vaccination and transfer.
- Using multiple hatch dates, causing a range of chick ages, will negatively affect uniformity.
- Flocks should be at 90% uniformity at the time of transfer to the laying facility.
- During the transfer of birds from rearing to laying facilities, there will be some loss of body weight.

Weigh 100 birds weekly to 30 weeks of age

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

Space Guidelines *(check local regulations)*



Requirements vary with the type of equipment used and environmental conditions.

Transfer to Laying House

- The flock can be moved into the production facility at 15–16 weeks of age or after administration of the last live vaccines.
- It is important that rearing and production cages use similar feed and water systems, to minimize stress.
- Any sex slips (males) should be removed around 7 weeks and at transfer.
- Supportive care to reduce stress, such as water-soluble vitamins, probiotics, vitamin C and increased dietary density, should be used 3 days before and 3 days after transfer.
- Weigh prior to transfer and monitor weight loss during transfer.
- Monitor flock water consumption frequently after transfer. Pre-transfer water consumption should be achieved within 6 hours after transfer to the laying house.
- Brighten the lights for three days after transfer until birds settle in their new environment.
- Inspect the flock and remove mortality daily.
- If mortality exceeds 0.1% per week, perform necropsies and other diagnostics to determine cause(s) of mortality.
- Transfer birds quickly to laying house. Transfer all birds the same day. Move early in the morning so birds can keep to a normal daily routine.

Enriched Cages

- Enriched cages address some of the welfare concerns of layers in cages by providing more space with environment enrichment devices, such as perches, nest boxes, scratch areas and abrasive pads for beak and toe shortening.
- Generally, bird group sizes range from 40–110 birds per cage.
- As group size increases, there is more competition for feed and water space and less stable social groups. This could lead to behavioral problems like feather pecking and piling. Cage enrichments help prevent these behavioral problems.

Alternative Systems

- Hy-Line Brown is an excellent choice for alternative management systems. For more information on managing Hy-Line Brown in barn, aviary and free range systems, see the Alternative Systems Management Guide at www.hyline.com.

Management Events for Commercial Layers

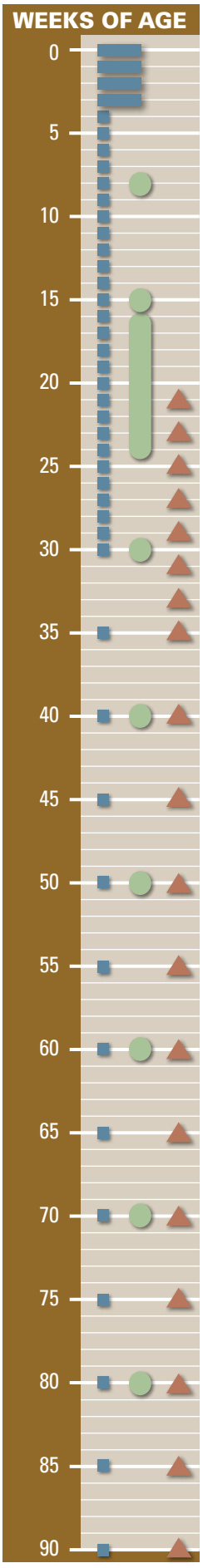
AGE	CAGE REARING
0	**24-48 hours before chicks arrive** Pre-heat the brooding house.
1 day	
2 days	
3 days	
4 days	
5 days	
6 days	
1 week	**7-10 days** Conduct precision beak trimming if not done in the hatchery (check local regulations).
8 days	
9 days	
10 days	
11 days	
12 days	
13 days	
2 weeks	**2 weeks** Cage paper should be removed by this time. Birds should be divided into cages on different levels to provide more space.
3 weeks	
4 weeks	
5 weeks	
6 weeks	
7 weeks	**7-13 weeks** Remove sex-slips (males) during vaccination handling.
8 weeks	
9 weeks	
10 weeks	
11 weeks	
12 weeks	
13 weeks	
14 weeks	**14-16 weeks** Increase light intensity in the house two weeks before transfer. Match layer house light intensity by transfer.
15 weeks	
16 weeks	**16 weeks** Transfer to the lay house early to allow birds to become familiar with the new environment and increase space.
17 weeks	**17 weeks** Begin light stimulation when pullets reach 1.40–1.48 kg body weight. In flocks using multiple pullet source flocks with a range of hatch ages, begin light stimulation with the youngest pullets. In flocks with poor uniformity, begin light stimulation with the lightest pullets.
18 weeks	
19 weeks	
20 weeks	
21 weeks	**21 weeks** Monitor egg weights every 2 weeks. Start controlling egg weight through feed formulation and house temperature changes when the average egg weight is within 2 g of the 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 or floor gently.*
- *Use experienced personnel that have been trained in proper procedures of bird handling.*
- *Continually observe crews for proper handling.*

Hold no more than three birds in one hand.

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 the beginning and end of feed lines.
- Mark cages and use the same cage every time body weight is monitored.
- Weigh birds on the same day of the week and the same time of day.

0–3 weeks

- Bulk weigh 10 boxes of 10 chicks.

4–29 weeks

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

30–90 weeks

- Weigh 100 birds individually every 5 weeks.
- Weigh birds in the 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 is available at www.hylinebodyweight.com.

AGES OF SERA COLLECTION

For more information, see the "Proper Collection and Handling of Diagnostic Samples" technical update at www.hyline.com.

Collect 10–20 sera samples per flock for titer determination.

8 weeks

- Assess early vaccination technique and disease exposure.

15 weeks

- Collect sera before transfer to lay house to assess possible change in disease exposure.
- It is common to not send to laboratory and freeze for future analysis in event of disease outbreak on lay farm.

16–24 weeks

- Collect sera at least 4 weeks after final inactivated vaccination to measure post-vaccination antibody response.
- It is useful to assess disease challenge after transfer to lay farm.

30–80 weeks

- Collect sera every 10 weeks.
- It is useful for assessing disease exposure during the laying period.

AGES TO MONITOR EGG WEIGHTS

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

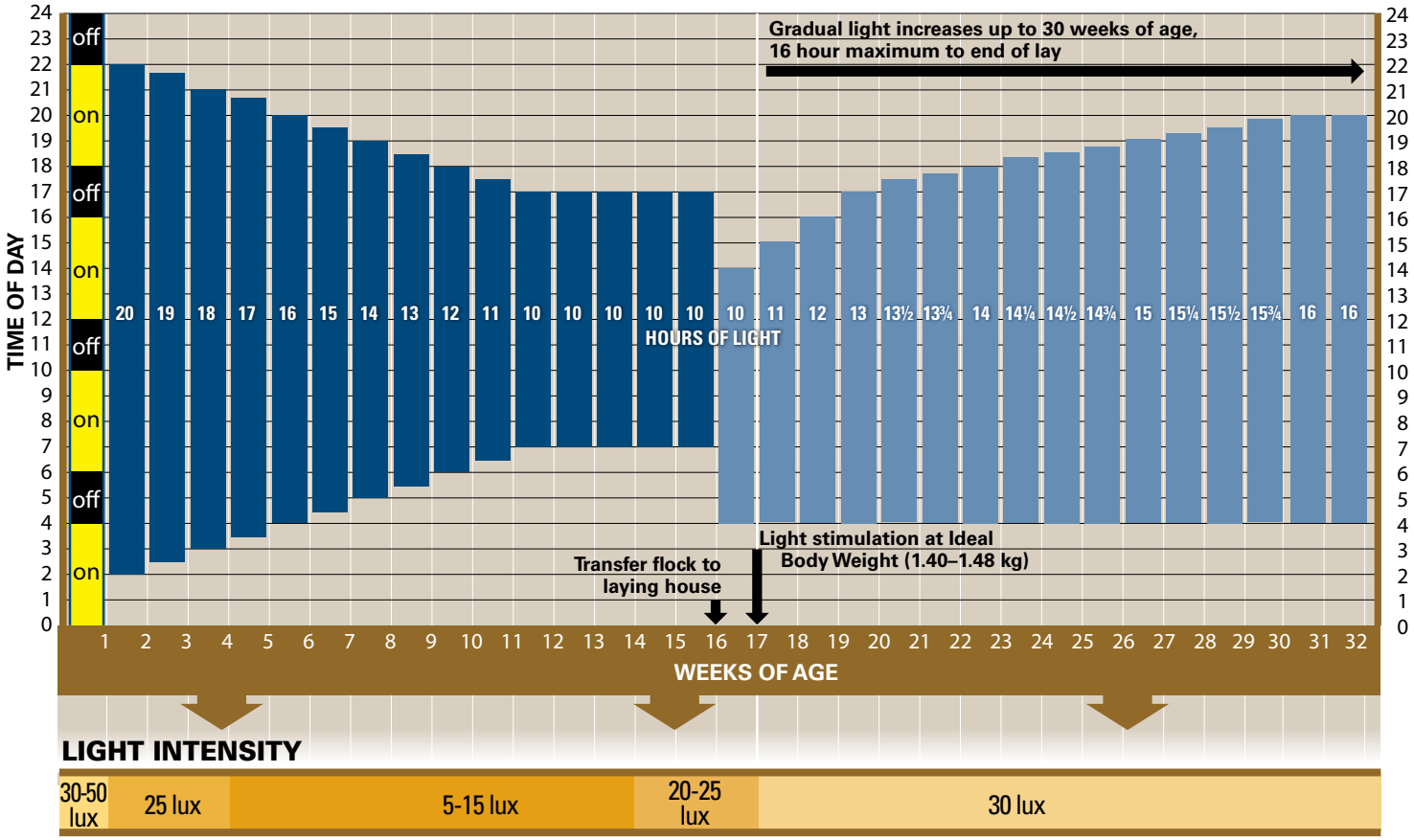
Good Lighting Practices

- 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.
- Position lights to minimize bright and dark areas in the house.
- 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 rearing and production houses should be matched at transfer.
- Light intensity should gradually increase 2 weeks before flock is transferred to the laying house (but not prior to 14 weeks of age). Final rearing house light intensity should match the laying house intensity.
- Begin light stimulation when flock reaches the 17-week body weight target (1.40–1.48 kg). Delay light stimulation if the flock is underweight or has poor uniformity.
- Light stimulation period should extend into the peaking period. Achieve 16 hours of light at approximately 30 weeks.
- Alternating the height of lights improves light distribution to all cage levels.

Light Program for Light-Controlled Housing

(www.hylineweblighting.com)

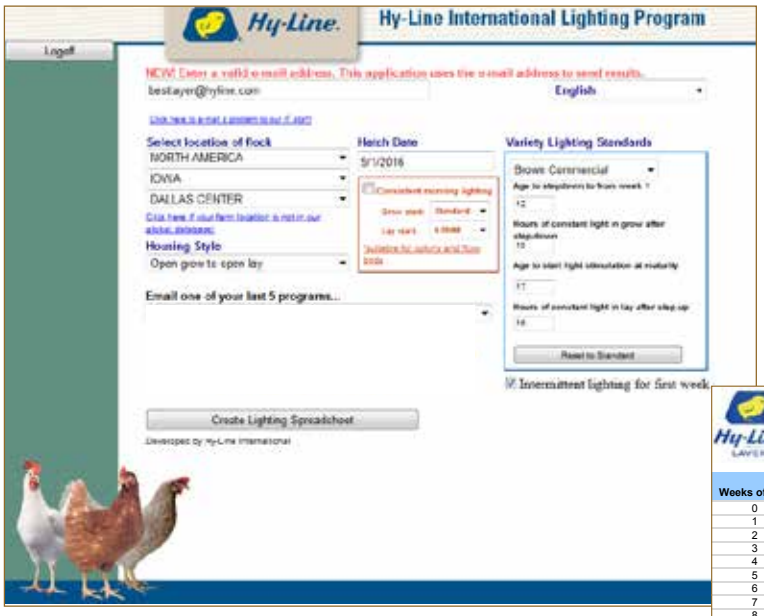
The Hy-Line Brown hen requires a slower step-down of light hours from 0–12 weeks to prevent early sexual maturity and promote good body weight uniformity.



- Light-controlled houses are those which use light traps around fans and air inlets and complete prevent the ingress of light from the outside. Houses that are not light controlled should use lighting programs for open-sided housing.
- An intermittent lighting program for chicks is preferred. If not using an intermittent lighting program from 0–7 days, then use 22 hours of light from 0–3 days and 21 hours of light from 4–7 days.
- "Lights on" time can be varied between houses in laying flocks to facilitate egg collection on multiple flock complexes.
- If the laying flock has a large spread in hatch ages and/or poor uniformity, light stimulate the flock based on the youngest hatch date or lightest birds.
- Use warm lights (2700–3500 K) in laying flocks to ensure sufficient red spectrum light.
- For more information on poultry lighting, see the "Understanding Poultry Lighting: A Guide to LED Bulbs and Other Sources of Light for Egg Producers" technical update at www.hyline.com.

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

The Hy-Line International Lighting Program can create custom lighting programs for your location and flock hatch date. The program finds the longest natural day length between 12–17 weeks of age and constructs an artificial lighting program that holds day length constant with artificial lights from 12–17 weeks. This prevents the flock from being stimulated by natural light before achieving the proper body weights.



- *On the first screen—enter e-mail address and select language.*
- *On the second screen, use dropdowns for "Select Location of Flock," "Hatch Date," "Variety Standards" and "Housing Style."*
- *Click on "Create Lighting Spreadsheet."*
- *Results will be e-mailed to you.*

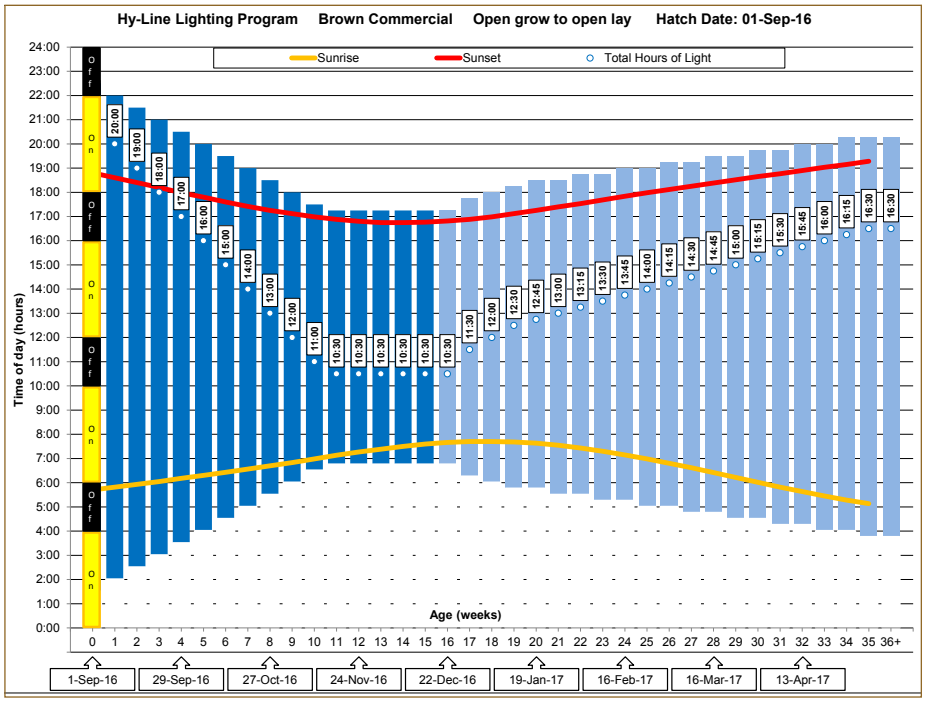
Lighting Program for : IOWA / DALLAS CENTER 93° 56' W 41° 43' N

Variety: Brown Commercial
House Type: Open grow to open lay
Hatch Date: 01-Sep-16 Standard daylight time

* Hours of constant light in lay after step-up : 16.5

Weeks of Age	Date	Sunrise	Lights on	Lights Off	Sunset	Total Hours of Light	Total Sunlight
0	1-Sep-16	5:42	1:30	22:30	18:48	21:00	13:06
1	8-Sep-16	5:49	2:00	22:00	18:36	20:00	12:47
2	15-Sep-16	5:56	2:30	21:30	18:24	19:00	12:28
3	22-Sep-16	6:03	3:00	21:00	18:12	18:00	12:09
4	29-Sep-16	6:11	3:30	20:30	17:59	17:00	11:48
5	6-Oct-16	6:18	4:00	20:00	17:48	16:00	11:30
6	13-Oct-16	6:26	4:30	19:30	17:36	15:00	11:10
7	20-Oct-16	6:34	5:00	19:00	17:25	14:00	10:51
8	27-Oct-16	6:42	5:30	18:30	17:15	13:00	10:33
9	3-Nov-16	6:50	6:00	18:00	17:07	12:00	10:17
10	10-Nov-16	6:59	6:30	17:30	16:59	11:00	10:00
11	17-Nov-16	7:08	6:45	17:15	16:53	10:30	9:45
12	24-Nov-16	7:16	6:45	17:15	16:48	10:30	9:32
13	1-Dec-16	7:23	6:45	17:15	16:45	10:30	9:22
14	8-Dec-16	7:30	6:45	17:15	16:45	10:30	9:15
15	15-Dec-16	7:36	6:45	17:15	16:46	10:30	9:10
16	22-Dec-16	7:40	6:45	17:15	16:49	10:30	9:09
17	29-Dec-16	7:42	6:15	17:45	16:53	11:30	9:11
18	5-Jan-17	7:42	6:00	18:00	16:59	12:00	9:17
19	12-Jan-17	7:41	5:45	18:15	17:07	12:30	9:26
20	19-Jan-17	7:38	5:45	18:30	17:15	12:45	9:37
21	26-Jan-17	7:33	5:30	18:30	17:24	13:00	9:51
22	2-Feb-17	7:26	5:30	18:45	17:32	13:15	10:06
23	9-Feb-17	7:18	5:15	18:45	17:41	13:30	10:23
24	16-Feb-17	7:09	5:15	19:00	17:50	13:45	10:41
25	23-Feb-17	6:59	5:00	19:00	17:59	14:00	11:00
26	2-Mar-17	6:48	5:00	19:15	18:07	14:15	11:19
27	9-Mar-17	6:37	4:45	19:15	18:15	14:30	11:38
28	16-Mar-17	6:25	4:45	19:30	18:23	14:45	11:58
29	23-Mar-17	6:13	4:30	19:30	18:31	15:00	12:18
30	30-Mar-17	6:01	4:30	19:45	18:39	15:15	12:38
31	6-Apr-17	5:49	4:15	19:45	18:46	15:30	12:57
32	13-Apr-17	5:38	4:15	20:00	18:54	15:45	13:16
33	20-Apr-17	5:27	4:00	20:00	19:02	16:00	13:35
34	27-Apr-17	5:17	4:00	20:15	19:09	16:15	13:52
35	4-May-17	5:08	3:45	20:15	19:17	16:30	14:09
36+			3:45	20:15		16:30	

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



Use of Shades in Open-Sided Housing

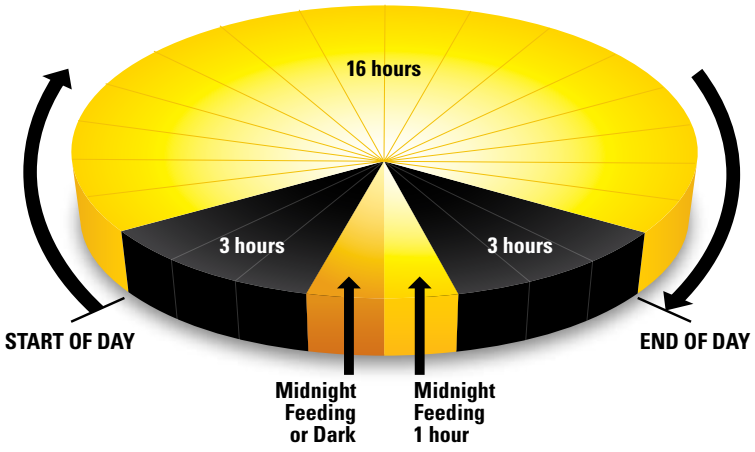
- Shades are an effective way to decrease light intensity in an open-sided house.
- Keep shades clean and free of dust to allow air flow.
- Use stir fans when using shades.
- Avoid direct sunlight on birds by using shades or roof overhangs.
- Black shades are preferred.

Midnight Feeding / Lighting Program

- Optional lighting technique that promotes greater feed consumption
- Used whenever more feed intake is desired in rearing or laying flocks
- Increases calcium absorption during the 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 the program by turning lights on for 1–2 hours in the middle of the dark period.
- Fill feeders before lights are turned on.
- There must be at least 3 hours of dark before and after the midnight feeding.
- Light provided during the midnight feeding is in addition to regular day length (i.e. 16 hours + midnight feeding).
- If midnight feeding is removed, reduce light gradually at a rate of 15 minutes per week.



Heat Stress

For information on management of layers in heat stress conditions, see the "Understanding Heat Stress in Layers" technical update at www.hyline.com.

Water Quality

- 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.
- Test water quality at least 1 time per year. The water source will determine the 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.
- The presence of coliform bacteria is an indicator that the water source has been contaminated with animal or human waste.
- When collecting a well water sample, let the water run for 2 minutes prior to collecting the sample. Water samples should be kept below 10°C and submitted to the 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 have 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 a significant impact on intestinal health, which will lead to under utilization of nutrients in feed.
- A decrease in flock water consumption is often the first sign of health problems and production drops.

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 manure moisture.
Chloride (Cl^-) [1]	250	Levels as low as 14 mg may be problematic if sodium is higher than 50 ppm.
Sulfate (SO_4^-) [1]	250	Higher levels may be laxative.
Iron (Fe) [1]	<0.3	Higher levels result in 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 is acceptable but concentrations above 50 ppm should be avoided if high levels of chloride, sulphate or potassium exist.
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	This is 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	The ORP range at which 2–4 ppm of free chlorine will effectively sanitize water at a 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. Avian Advice 10(3): 10–15 University of Arkansas Cooperative Extension Service, Fayetteville

Air Quality

Air Movement (m³ / 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

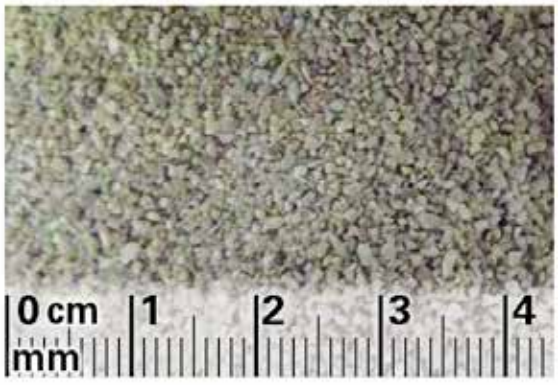
Acknowledgment: Dr. Hongwei Xin, Professor, Department of Agriculture and Biosystems Engineering and Department of Animal Science, Iowa State University, Ames, Iowa, USA

- Production house should be at 18–25°C and 40–60% humidity.
- The general rule for determining required fan capacity—4 m³ of air movement / kilogram of body weight per hour.
- Ventilation is essential to:
  - Remove moisture from house
  - Remove excessive heat
  - Provide each bird with an adequate supply of oxygen
  - Remove carbon dioxide produced by birds
  - Remove dust particles
  - Dilute aerosolized pathogenic organisms
- Allowable levels of gases at floor level in the house are: ammonia (NH_3) < 25 ppm; carbon dioxide (CO_2) < 5000 ppm; carbon monoxide (CO) < 50 ppm.

Calcium Particle Size

PARTICLE SIZE	STARTER, GROWER, DEVELOPER	PRE-LAY	WEEKS 17–35	WEEKS 36–55	WEEKS 56–74	WEEKS 75–90	POST-MOLT
Fine (0–2 mm)	100%	50%	50%	40%	35%	35%	35%
Coarse (2–4 mm)	–	50%	50%	60%	65%	65%	65%

- The appropriate particle size depends on the solubility of limestone.
- Dietary calcium levels may need to be adjusted based on limestone solubility.
- Limestone dark in color is geologically older, containing more impurities (typically magnesium) and is generally lower in solubility and calcium availability.
- Oyster shell and other marine shells are good sources of soluble calcium.



Fine calcium (0–2 mm)

Coarse calcium (2–4 mm)

Photos courtesy of Longcliff Quarries Ltd.

Feed Particle Size (Grist)

A sieve shaker separates a feed sample into categories based on particle size.

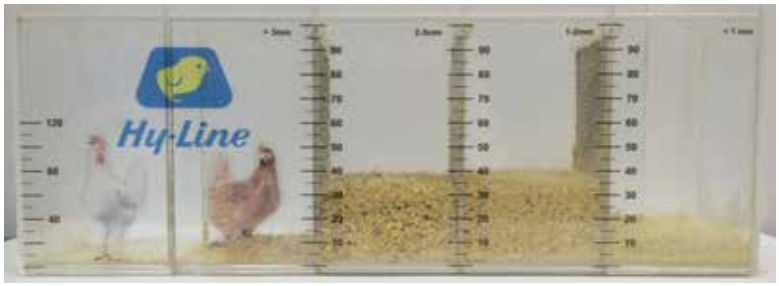
- Use on the farm to check feed particle size from the feed mill—sample taken on delivery or from feed bins.
- Use to assess the uniformity of feed particle size throughout the feeding system—samples are taken from various points.

Too many fine feed particles:

- Feed intake and nutrient absorption decreases
- Dust in house increases

Too many coarse feed particles:

- Birds selectively eat large particles
- Risk of feed separation increases



Hy-Line Sieve Shaker

OPTIMAL FEED PARTICLE PROFILE

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

Best Practices

- A 3–4 hour gap between mid-day feedings allows birds to consume fine particles. Daily consumption of fine feed particles is important for a balanced nutrient intake.
- Add a 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.

ITEM [1,2,3,4]	IN 1000 KG COMPLETE DIET	
	Rearing Period	Laying Period
Vitamin A, IU	10,000,000	8,000,000
Vitamin D_3[5], IU	3,300,000	3,300,000
Vitamin E, g	25	20
Vitamin K (menadione), g	3.5	2.5
Thiamin (B_1), g	2.2	2.5
Riboflavin (B_2), g	6.6	5.5
Niacin (B_3)[6], g	40	30
Pantothenic acid (B_5), g	10	8
Pyridoxine (B_6), g	4.5	4
Biotin (B_7), mg	100	75
Folic acid (B_9), g	1	0.9
Cobalamine (B_{12}), mg	23	23
Choline[7], g	110	110
Manganese[8], g	90	90
Zinc[8], g	85	80
Iron[8], g	30	40
Copper[8], g	15	8
Iodine, g	1.5	1.2
Selenium[8], g	0.25	0.22

[1] Minimum recommendations for rearing and laying periods. Local regulations may limit dietary content of individual vitamins or minerals.

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

[3] Vitamin and mineral recommendations vary 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 individual production processes.

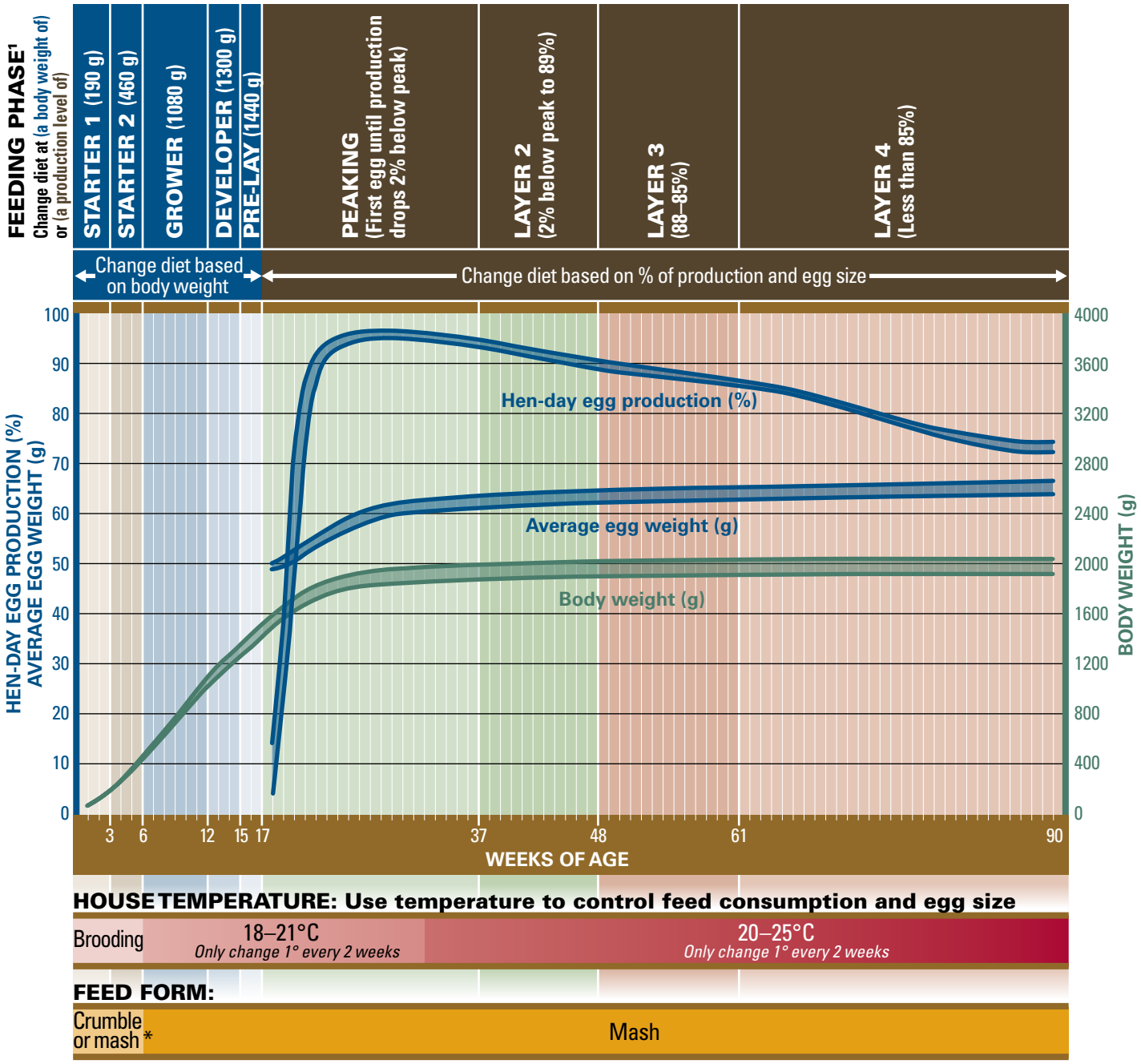
[5] A proportion of Vitamin D_3 can be supplemented as 25-hydroxy D_3 according to supplier's recommendations and applicable limits.

[6] Higher levels of Niacin are recommended in non-cage systems.

[7] Inclusion may require adjustment when other dietary sources are considered.

[8] Greater bioavailability and productivity may be possible with use of chelated mineral sources.

Phase Feeding to Meet the Hy-Line Brown's Nutritional Needs



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

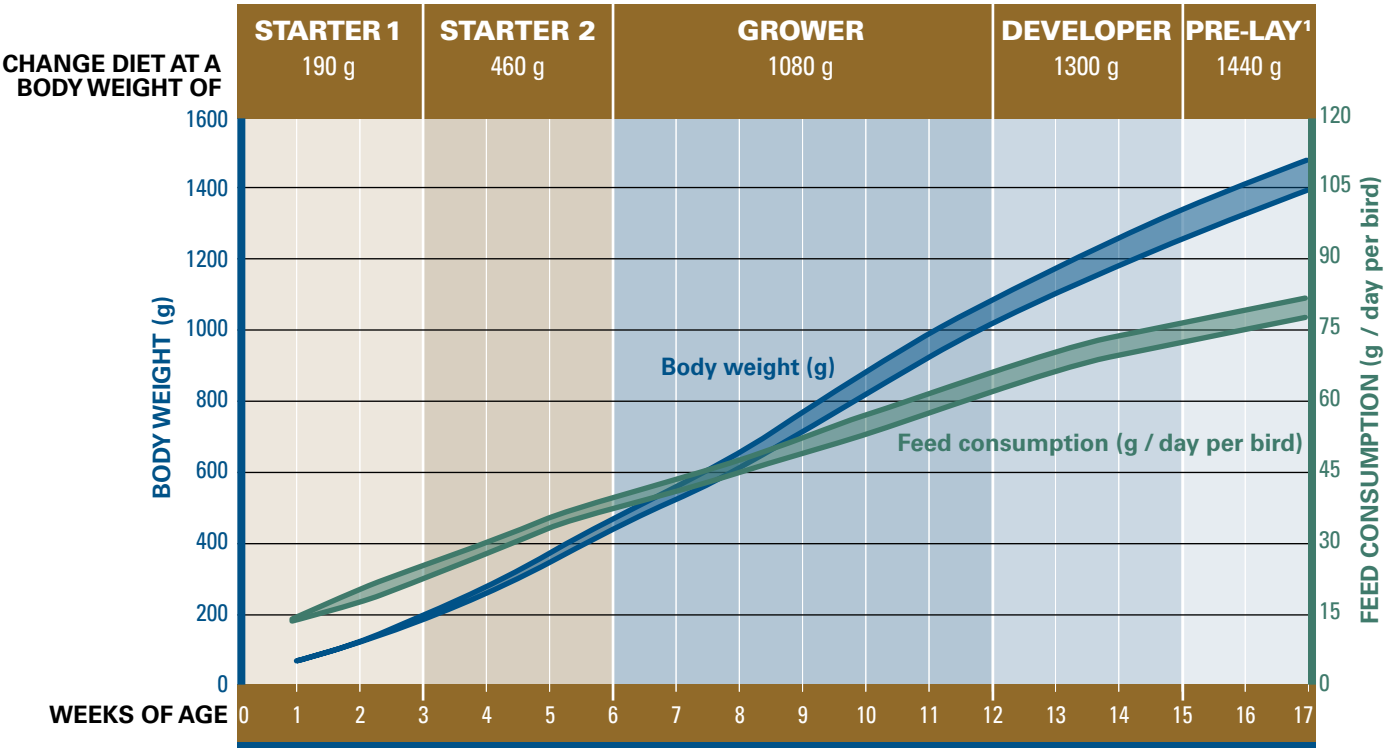
Control of Ambient House Temperature

- 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 are able to maintain adequate air quality at these temperatures.
- Lower (colder) house temperatures after peak 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.
- Place temperature sensors to measure temperature inside of cage. The temperature in walkways is significantly colder than the temperature inside cages, especially in stack deck belted house systems.
- High environmental temperatures have a depressing effect on feed intake.

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 at an early age.
- Egg-weight control is achieved by limiting amino acid consumption and ensuring that feed intake is not too high.
- Monitor egg weight every 2 weeks until 35 weeks of age, then every 5 weeks. Start controlling egg weight when average egg weight is within 2 g of target.

Rearing Period Nutritional Recommendations



NUTRITION	RECOMMENDED NUTRIENT CONCENTRATION				
Metabolizable energy[2], kcal/kg	2867–3043	2867–3043	2800–3021	2734–3021	2778–2999
Metabolizable energy[2], MJ/kg	12.00–12.74	12.00–12.74	11.72–12.64	11.44–12.64	11.63–12.55
	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	1.00	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)[7], %	1.00	1.00	1.00	1.00	1.00

[1] Do not feed Pre-Lay Diet earlier than 15 weeks of age. Do not feed Pre-Lay later than first egg as it contains insufficient calcium to support egg production. Use Pre-Lay Diet to introduce large particle calcium.

[2] Recommended energy range is based on raw material energy values shown in feed ingredient 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.

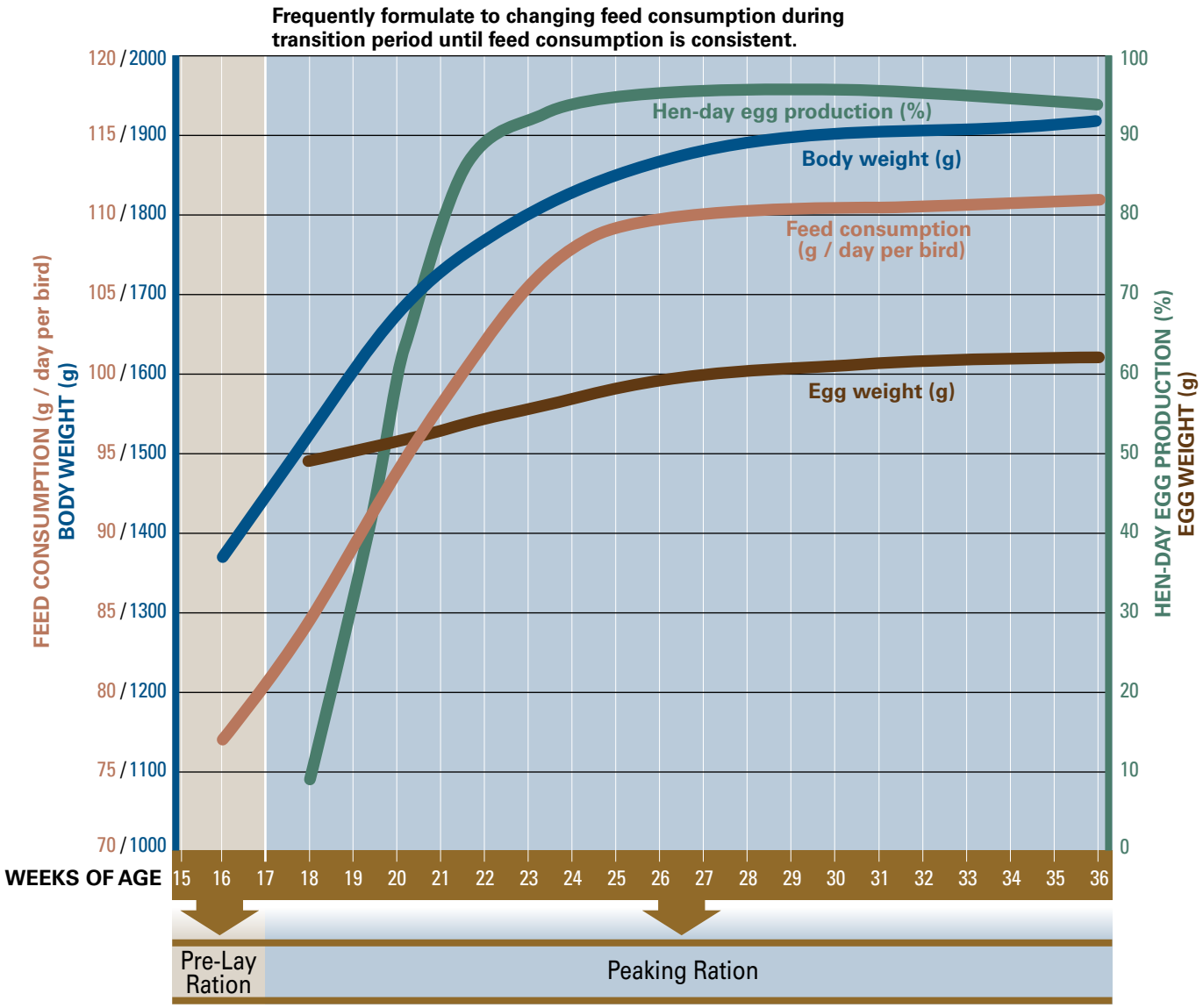
[4] Diets should always be formulated to provide required intake of amino acid. Concentration of crude protein in diet will vary with raw material used. Crude protein value provided is an estimated typical value only.

[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.

[7] Oil levels can be increased to 2.0% in starter diets when given as a mash to control dust and increase feed palatability.

Transition Period from Rear to Peak Egg Production



Pre-Lay Ration

- Plan to feed for a maximum of 10–14 days before point of lay.
- Feed when most pullets show reddening of combs.
- It is important to increase medullary bone reserves.
- Begin introducing large particle calcium in Pre-Lay Diet.
- Discontinue pre-lay feeding with the commencement of egg production.

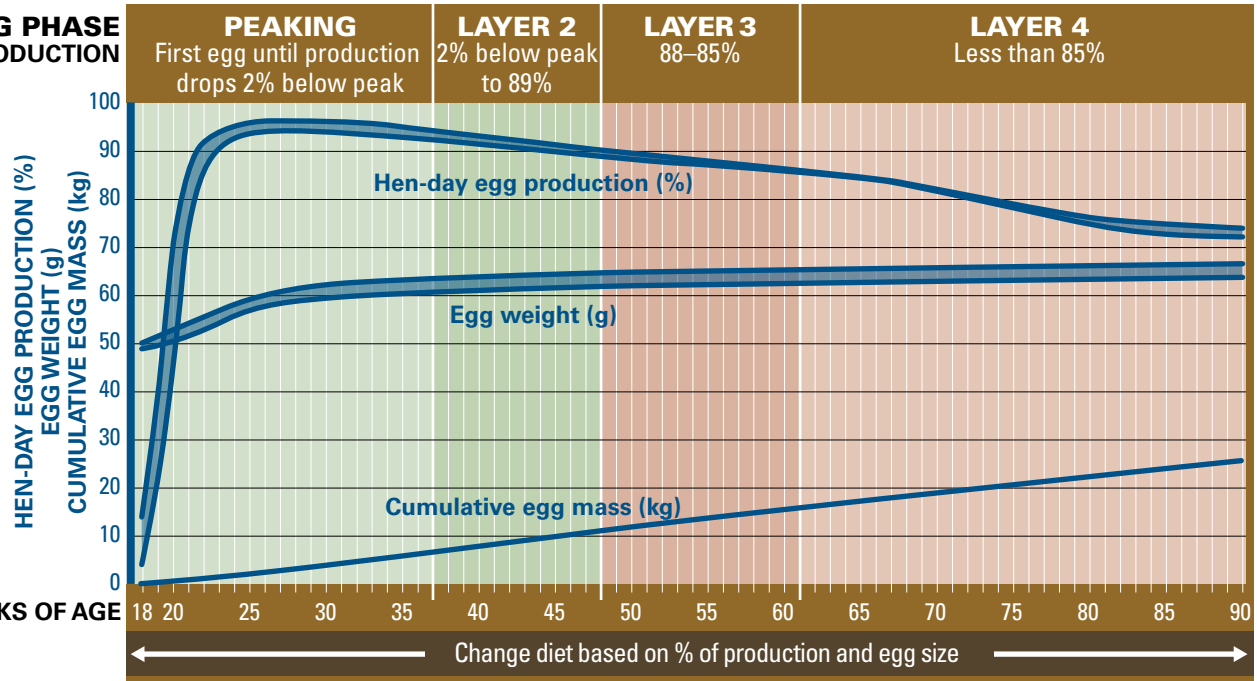
Transition Period

- Occurring during the transition period:
  - 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 the transition period and may result in low peak and poor persistency of egg production.
- Monitor feed intake carefully during transition and adjust dietary nutrient concentration according to actual feed intakes.

Peaking Ration

- Formulations for low feed intakes (88–95 g / day per bird) should be given as the flock enters egg production to better meet nutrient requirements.
- Begin Peaking Diet with onset of lay (1% egg production).
- Ensure that Peaking Diet is in the feeders when first eggs are laid, not in the feed bin.
- Birds should continue to grow during peaking period. Poor nutrition during this period can lead to loss of body weight and soft bones.
- Feed intake may be reduced if birds are not accustomed to extra large particle calcium (i.e. not using a Pre-Lay Diet).
- Monitor keel bone development during the peaking period. For more information on keel bone scoring, see the "Understanding the Role of the Skeleton in Egg Production" technical update at www.hyline.com.

Production Period Nutritional Recommendations



NUTRITION	RECOMMENDED DAILY NUTRIENT INTAKE[1]			
Metabolizable energy[2], kcal/kg	2778–2911	2734–2867	2679–2867	2558–2833
Metabolizable energy[2], MJ/kg	11.63–12.18	11.44–12.00	11.21–12.00	10.71–11.86
	Standardized Ileal Digestible Amino Acids / Total Amino Acids[3]			
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[4], g/day	17.00	16.75	16.00	15.50
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

CALCIUM, PHOSPHORUS AND LIMESTONE PARTICLE SIZE CHANGES BASED ON AGE	Weeks 17–35	Weeks 36–55	Weeks 56–74	Weeks 75–90
Calcium[5,6], g/day	4.20	4.30	4.50	4.80
Phosphorus (available)[5,7], mg/day	460	420	380	360
Calcium Particle Size (fine:coarse) (see page 17)	50% : 50%	40% : 60%	35% : 65%	35% : 65%

[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 feed ingredient 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] Calcium and available phosphorus requirements are determined by flock age. When production remains higher and diets are fed for longer than ages shown, it is recommended to increase to calcium and phosphorus concentrations of next feeding phase.

[6] Calcium carbonate particle size recommendation 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.

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

FEEDING PHASE / PRODUCTION	PEAKING — First egg until production drops 2% below peak						LAYER 2 — 2% below peak to 89%					LAYER 3 — 88–85%					LAYER 4 — Less than 85%				
NUTRITION	**RECOMMENDED CONCENTRATION[1]**																				
Metabolizable energy[2], kcal/kg	2778–2911						2734–2867					2679–2867					2558–2833				
Metabolizable energy[2], 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[3]																				
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[4], %	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
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

CALCIUM, PHOSPHORUS AND LIMESTONE PARTICLE SIZE CHANGES BASED ON AGE	Weeks 17–35						Weeks 36–55					Weeks 56–74					Weeks 75–90				
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
Calcium[5,6], %	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	4.85	4.62	**4.40**	4.21	4.03
Phosphorus (available)[5,7], %	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	0.36	0.35	**0.33**	0.32	0.30
Calcium Particle Size (fine:coarse) (see page 17)	50% : 50%						40% : 60%					35% : 65%					35% : 65%				

[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 feed ingredient 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] Calcium and available phosphorus requirements are determined by flock age. When production remains higher and diets are fed for longer than ages shown, it is recommended to increase to calcium and phosphorus concentrations of next feeding phase.

[6] Calcium carbonate particle size recommendation 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.

Non-Fasting Molt Recommendations

(Check with local authorities 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-Fasting Molt

- Hy-Line laying hens will perform very well after a rest.
- The optimum age for molting is usually between 65 (early) to 75 (late) 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.
- Birds need 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.
- Best post-molt egg production is achieved after complete cessation of egg production that lasts for at least 2 weeks.
- The goal is to maintain 18 week body weight (1.47–1.57 kg) during rest period.
- Reducing body weight to 18 week body weight (approximately 23% reduction) will result in best post-molt performance.
- After initial body weight loss, body weight can be held steady by a combination of adjusting the number of feedings per day and / or a shift to a higher-energy (laying-hen-type) diet.
- Closely monitor body weight of flock during molt process.
- Body weights should be collected twice per week, from the 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-Fasting Molt 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	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 23% 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] May include a probiotic or prebiotic 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 in a single day (i.e., from 8 hours to 16 hours in a single day) or two weekly steps (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 NUTRIENT CONCENTRATION
Metabolizable energy[1], kcal/kg	2600–2800
Metabolizable energy[1], MJ/kg	10.90–11.70
	Standardized Ileal Digestible Amino Acids / Total Amino Acids[2]
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[3], %	8.50
Calcium[4], %	1.3–2.0
Phosphorus (available), %	0.25
Sodium[5], %	0.03
Chloride, %	0.03

[1] Recommended energy range is based on energy values shown in feed ingredient 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.

[2] 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.

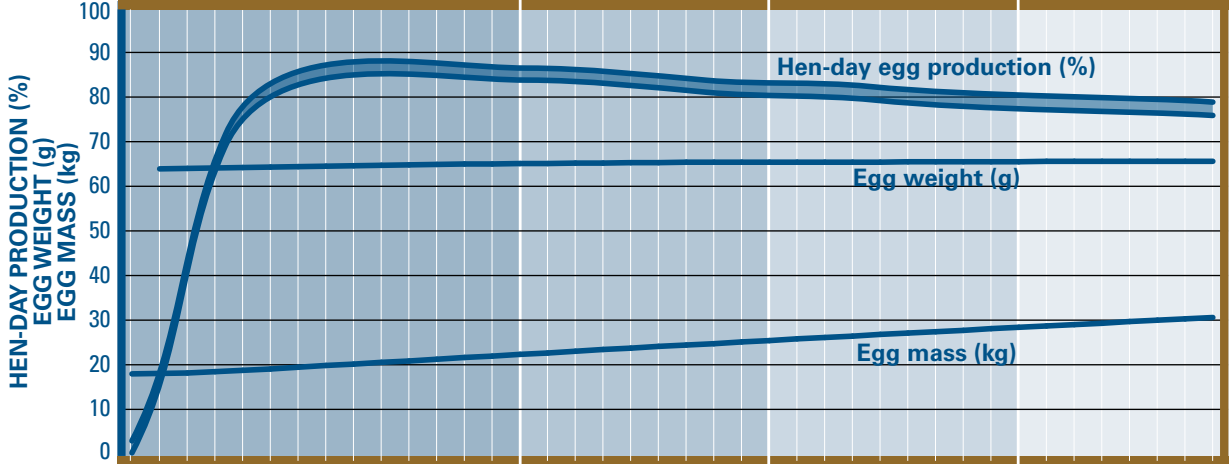
[3] Diets should always be formulated to provide required intake of amino acid. Concentration of crude protein in diet will vary with raw material used. Crude protein value provided is an estimated typical value only.

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

[5] 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%



WEEKS OF AGE	71	85	94	103	110

Change diet based on % of production

NUTRITION	RECOMMENDED NUTRIENT INTAKE[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
	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 CHANGES BASED ON AGE

	Weeks 71–82					Weeks 83–91					Weeks 92–100					Weeks 101–110				
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
Calcium Particle Size (fine:coarse) (see page 17)	35% : 65%					35% : 65%					35% : 65%					35% : 65%				

[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.

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[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 the farm should be strictly controlled.
- Visitors to the farm should be limited to those essential for its operation.
- Visits should be documented in a logbook.
- All visitors and workers should shower at a 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 the farm is an opportunity for disease to be introduced, as trucks and crews have often been on other farms.
- A single-aged rearing farm using an 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. They are also responsible for house-to-house spread of disease on a farm.

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

Cleaning and Disinfection

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

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

Vertically Transmitted Diseases

- Some diseases are known to be transmitted from infected breeders to progeny.
- Disease-free breeders are the first step in control of these diseases for commercial layers.
- All breeders directly under Hy-Line International's control are free of lymphoid leukosis, *Mycoplasma gallisepticum, Mycoplasma synoviae, Salmonella pullorum, Salmonella gallinarum, Salmonella enteritidis, Salmonella typhimurium* and other Salmonella species.
- Due to the possibility of horizontal transmission of these diseases, later generations may not remain free.
- It is the responsibility of breeding and commercial flock owners to prevent horizontal transmission of these diseases and to 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 the hatchery or by feed or water application during the first few days in the brooder house.
- Control of flies and beetles, which are vectors of coccidia spread.
- Thorough cleaning and disinfection of houses reduces challenge pressure.
- Limit bird access to manure belts.
- Cocci vaccines require cycling; discuss this with the vaccine manufacturer.

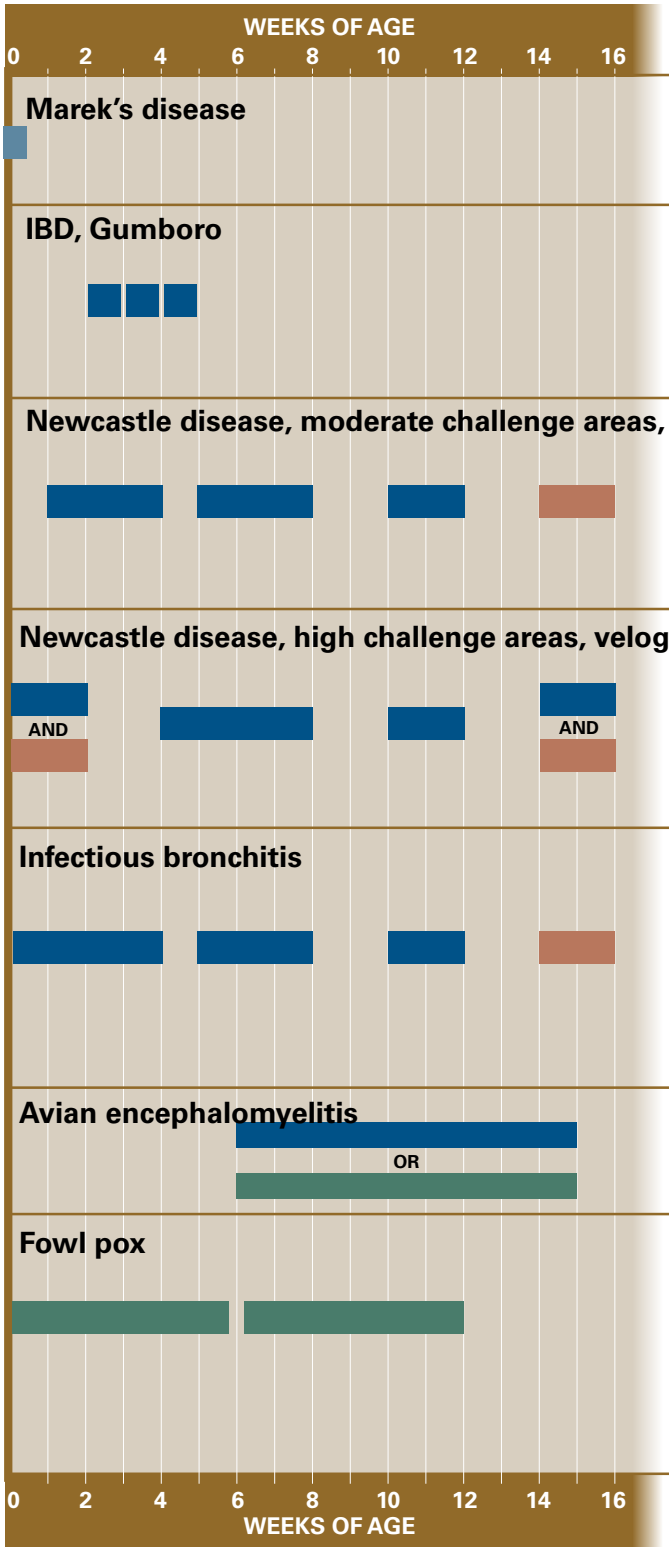
Vaccination Recommendations

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 Marek's disease, Newcastle disease (NDV), infectious bronchitis (IB), infectious bursal disease (IBD or Gumboro), avian encephalomyelitis (AE) and fowl pox. Other vaccinations are added to the program as local disease challenges dictate.

A single program cannot be recommended for all regions. Follow label instructions provided by the vaccine manufacturer. Use only approved vaccines. 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
- At least one live vaccination during grow should be applied as spray
- Live boosting vaccinations every 30–60 days during production period may be needed to maintain high immunity

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 mucosal 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 mucosal 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
- For more information, see the "Fowl Pox in Layers" technical update at www.hyline.com

Live hatchery vaccines, given subcutaneous

Live vaccines, administered by drinking water, spray or eyedrop

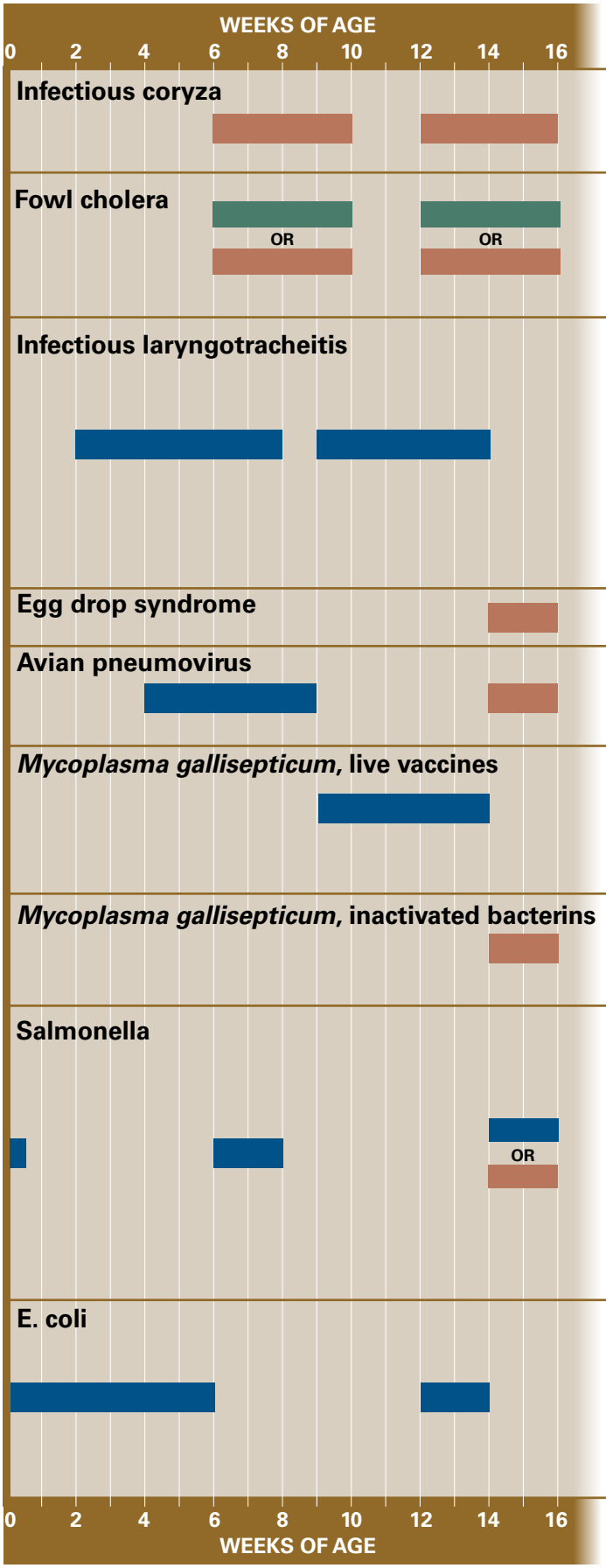
Live vaccines, administered via wing-web inoculation

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. Follow label instructions provided by the vaccine manufacturer. Use only approved vaccines. Consult a local veterinarian for advice in designing an effective vaccination program for your farm.



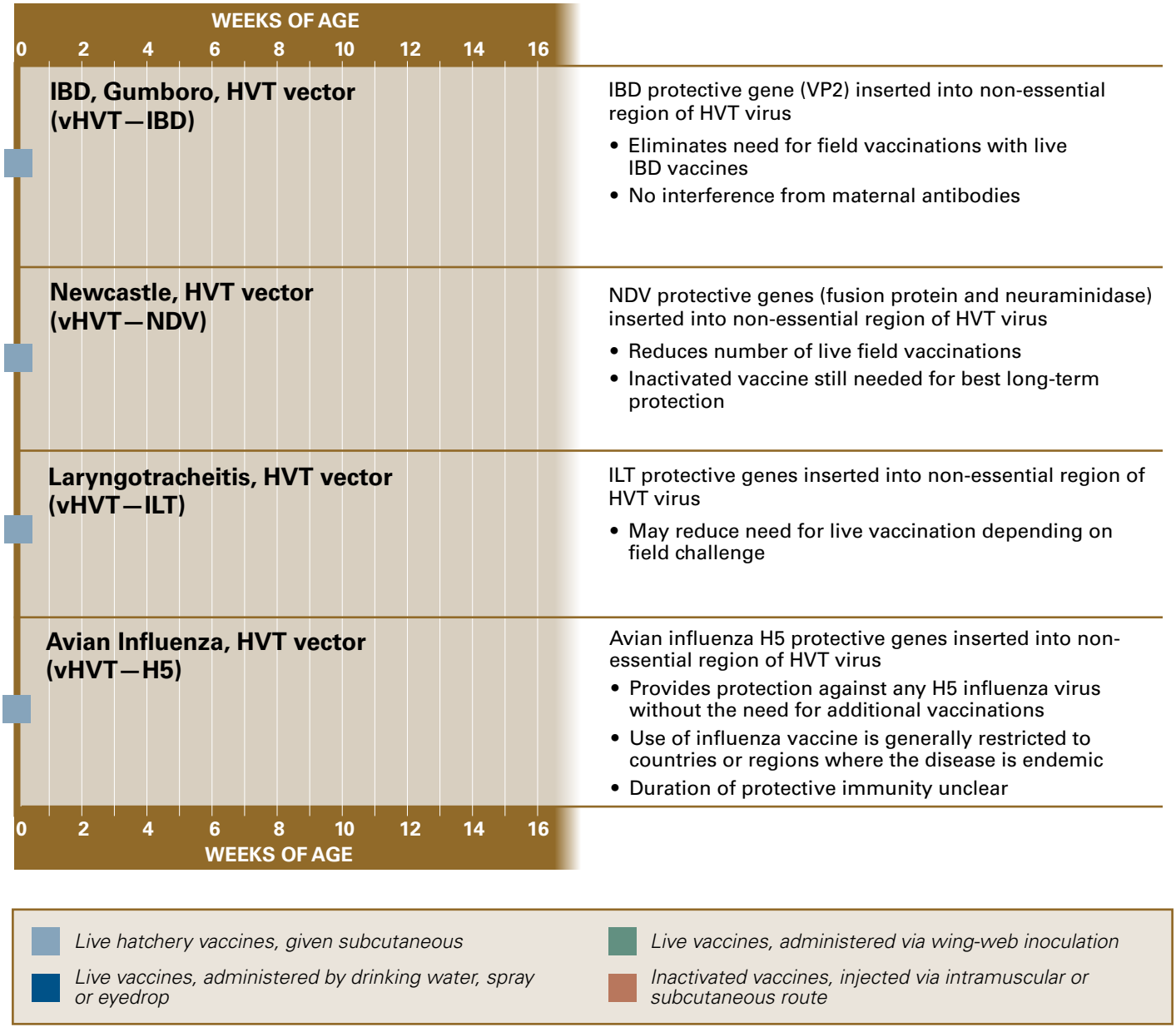
- **Infectious coryza**
  - 2 vaccinations separated by 4 weeks
  - Autogenous bacterins utilizing local isolates are sometimes used
- **Fowl cholera**
  - 2 vaccinations separated by 4 weeks
  - Autogenous bacterins utilizing local isolates are sometimes used
  - Live cholera vaccines such as M-9 or 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**
  - Vaccination programs using both live and killed vaccines are 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
  - For more information on MG, see the "MG Control in Commercial Layers" technical update at www.hyline.com
- ***Mycoplasma gallisepticum*, inactivated bacterins**
  - Often MG bacterins are in combination with Newcastle and bronchitis
  - For more information on MG, see the "MG Control in Commercial Layers" technical update at www.hyline.com
- **Salmonella**
  - Salmonella vaccination reduces colonization of internal organs and intestinal tract, reduces intestinal shedding into the environment
  - 2 or 3 live vaccinations with modified Salmonella typhimurium or Salmonella enteritidis strains followed by an inactivated bacterin offers best protection
  - Live vaccines provide good protection against strains within same serogroup and variable protection against strains of other serogroups
  - Inactivated bacterins can provide targeted protection against a particular strain
- **E. coli**
  - Live attenuated vaccine recommended for coarse spray application in the hatchery or in the rearing house the first few weeks
  - Second vaccination at 12-14 weeks
  - Can be combined with other live sprayed vaccinations
  - For more information on E. coli, see the "Colibacillosis in Layers" technical update at www.hyline.com

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 the 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.



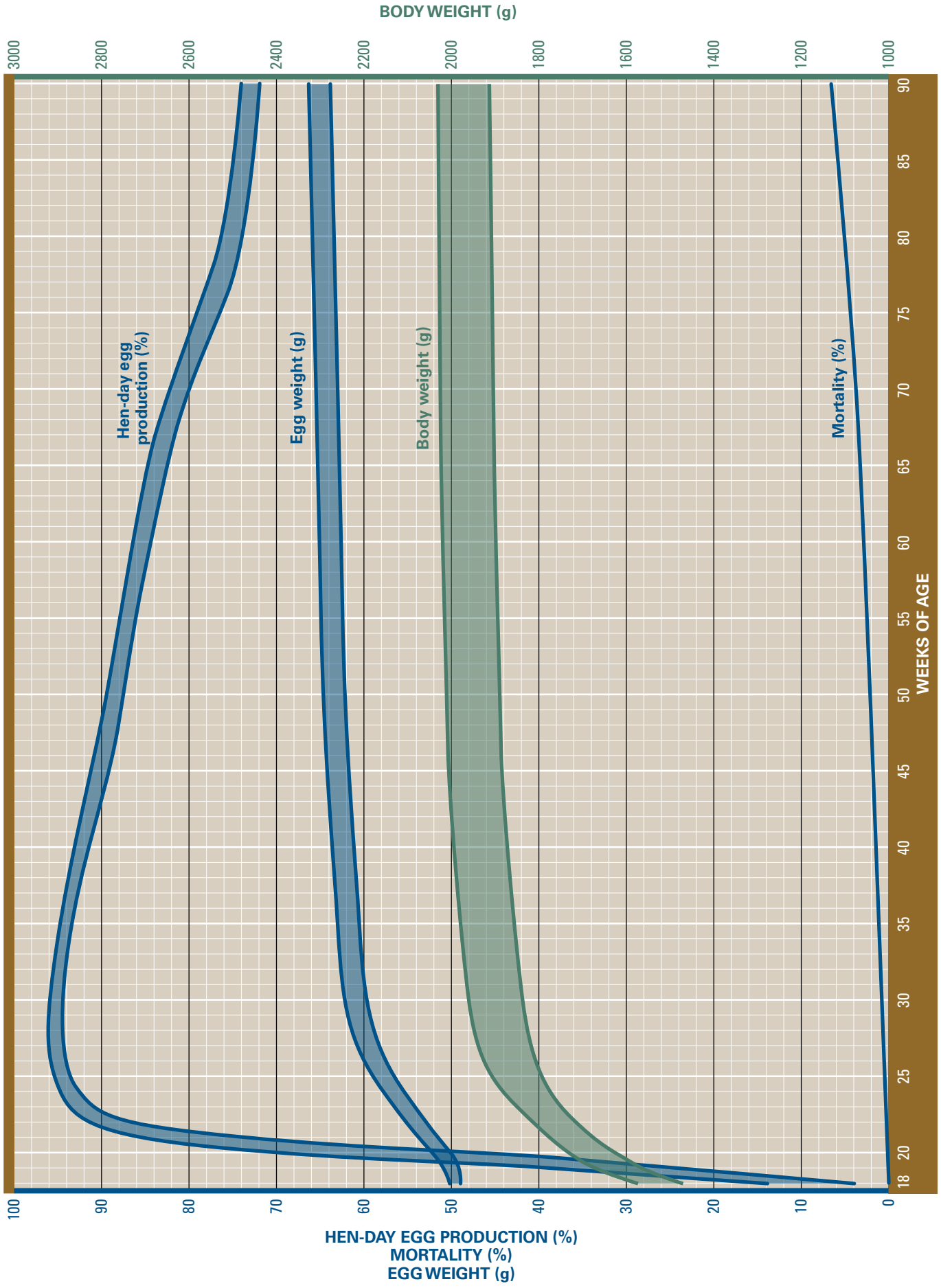
Live hatchery vaccines, given subcutaneous

Live vaccines, administered by drinking water, spray or eyedrop

Live vaccines, administered via wing-web inoculation

Inactivated vaccines, injected via intramuscular or subcutaneous route

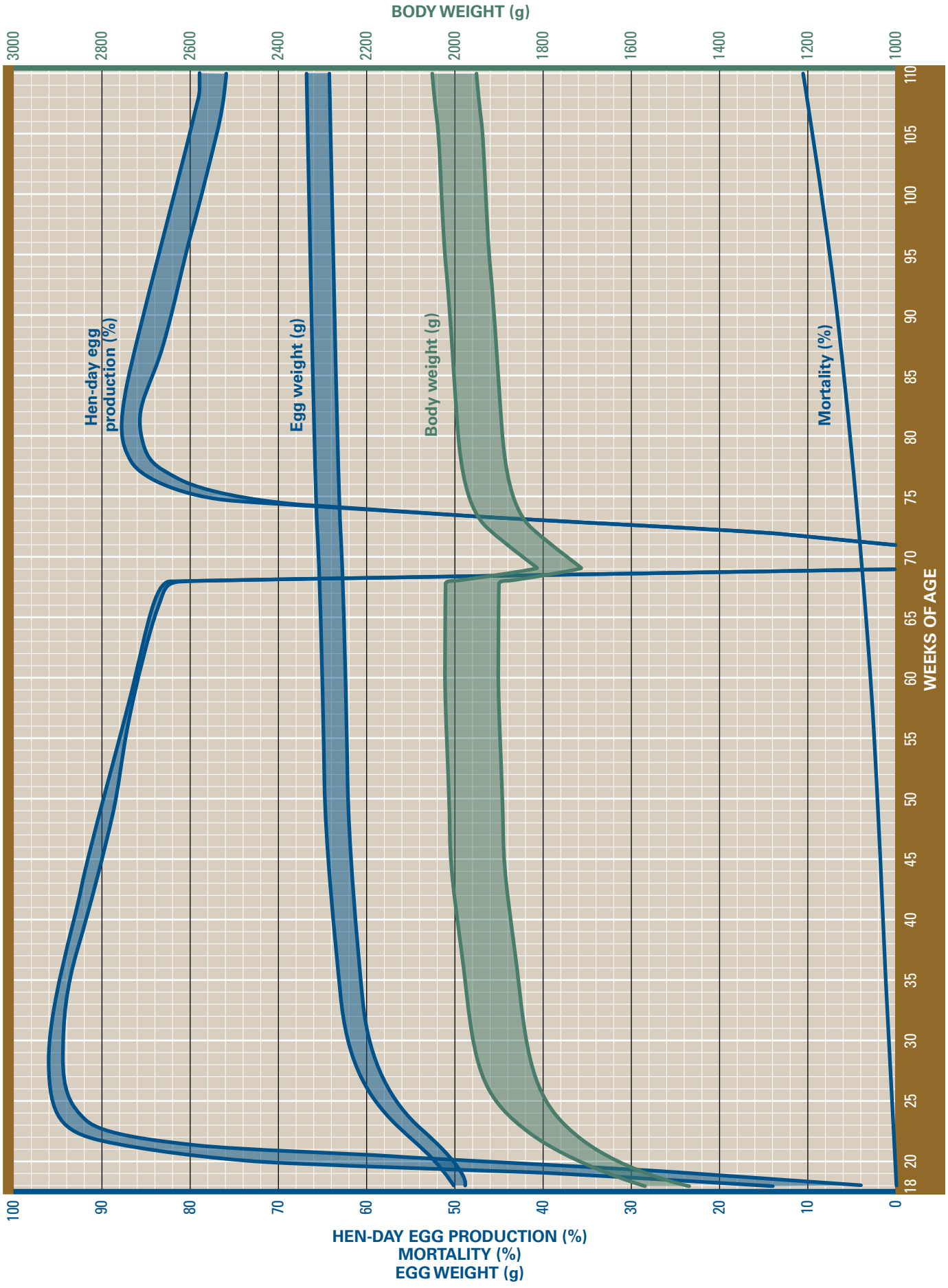
Performance Graph



Post-Molt Performance Table

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	54.0 – 64.0	18.0	–
70	0 – 0	299.2 – 309.4	294.1 – 304.2	3.9	1.74 – 1.84	54.0 – 64.0	18.0	–
71	0 – 0	299.2 – 309.4	294.1 – 304.2	4.1	1.77 – 1.87	64.0 – 95.0	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	485.8 – 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

Post-Molt Performance Graph

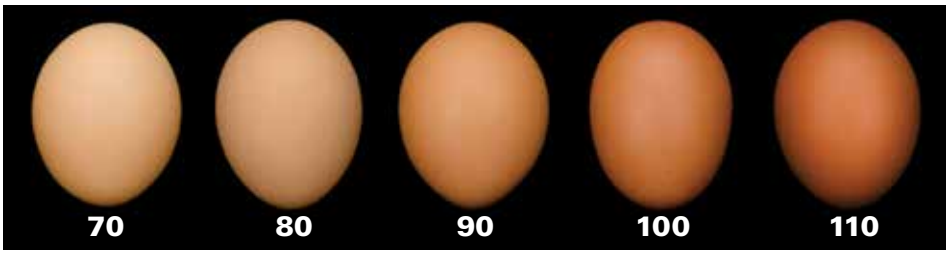


Egg Standards and Egg Size Distribution

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



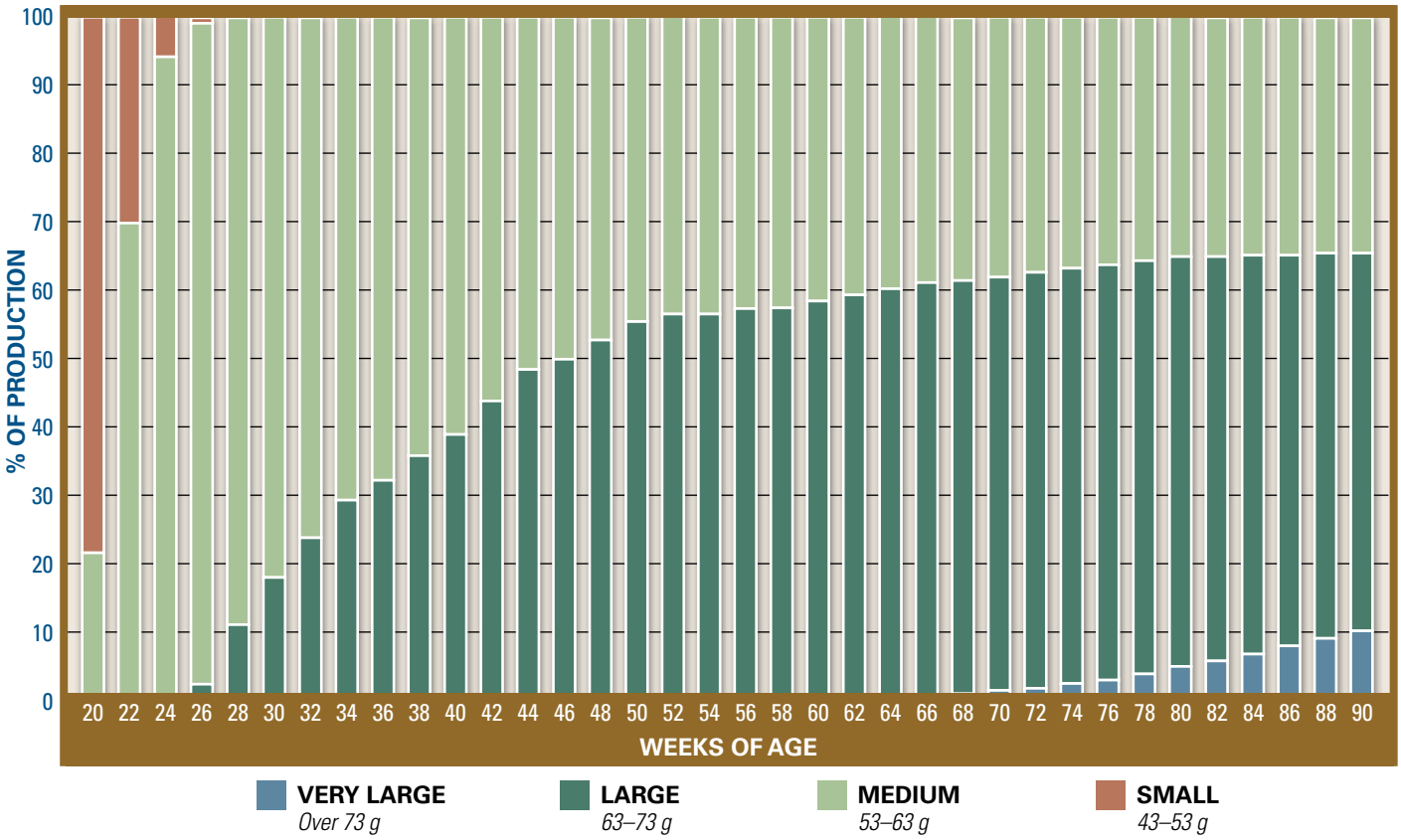
- For more information on egg quality, see the "The Science of Egg Quality" technical update and the "Hy-Line Brown – Selecting for Superior Egg Quality" product update at www.hyline.com.

Egg Size Distribution *(continued)*

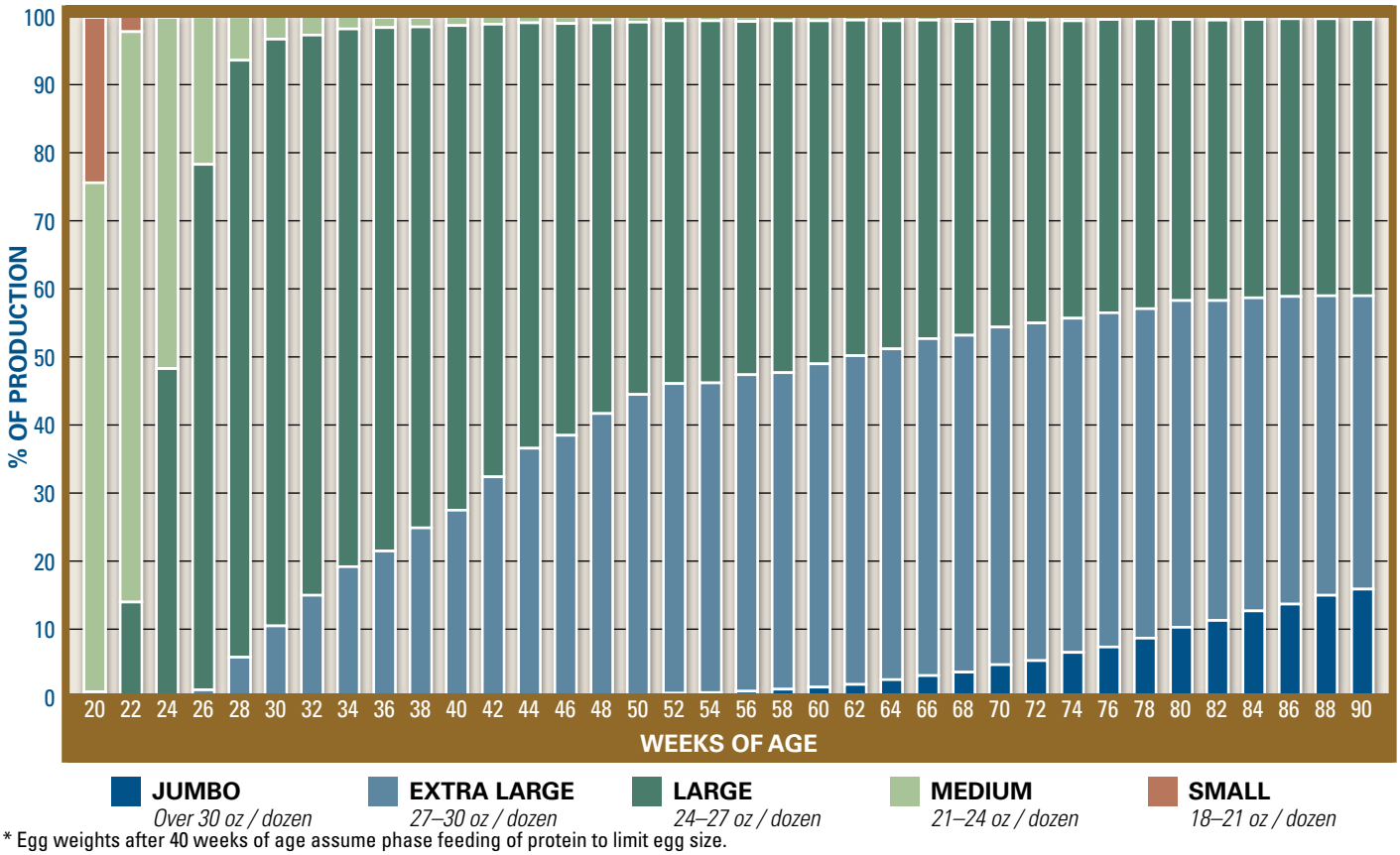
EGG SIZE DISTRIBUTION—U.S.STANDARDS						
AGE (weeks)	AVERAGE EGG WEIGHT (lbs / case)	% JUMBO Over 30 oz / dozen	% EXTRA LARGE 27–30 oz / dozen	% LARGE 24–27 oz / dozen	% MEDIUM 21–24 oz / dozen	% SMALL 18–21 oz / dozen
20	40.6	0.0	0.0	0.8	74.8	24.3
22	43.0	0.0	0.0	14.0	83.8	2.3
24	44.9	0.0	0.1	48.2	51.6	0.1
26	46.4	0.0	1.1	77.2	21.7	0.0
28	47.8	0.0	5.9	87.7	6.4	0.0
30	48.3	0.0	10.5	86.2	3.4	0.0
32	48.7	0.0	15.0	82.3	2.8	0.0
34	49.0	0.0	19.2	79.0	1.9	0.0
36	49.1	0.0	21.5	76.9	1.5	0.0
38	49.3	0.0	24.9	73.6	1.4	0.0
40	49.4	0.0	27.5	71.2	1.3	0.0
42	49.7	0.1	32.3	66.5	1.2	0.0
44	49.9	0.1	36.5	62.5	1.0	0.0
46	50.0	0.2	38.3	60.5	1.0	0.0
48	50.2	0.3	41.4	57.4	0.9	0.0
50	50.3	0.4	44.1	54.7	0.8	0.0
52	50.4	0.6	45.5	53.3	0.7	0.0
54	50.4	0.7	45.5	53.2	0.7	0.0
56	50.5	0.9	46.5	51.9	0.7	0.0
58	50.5	1.2	46.5	51.7	0.7	0.0
60	50.6	1.5	47.5	50.4	0.6	0.0
62	50.6	1.9	48.3	49.3	0.6	0.0
64	50.7	2.6	48.6	48.2	0.6	0.0
66	50.8	3.2	49.5	46.8	0.6	0.0
68	50.9	3.7	49.5	46.1	0.6	0.0
70	51.0	4.8	49.6	45.2	0.5	0.0
72	51.0	5.4	49.6	44.5	0.5	0.0
74	51.1	6.6	49.1	43.7	0.5	0.0
76	51.2	7.4	49.1	43.1	0.5	0.0
78	51.3	8.7	48.4	42.6	0.4	0.0
80	51.4	10.3	48.0	41.3	0.4	0.0
82	51.4	11.3	47.0	41.2	0.4	0.0
84	51.5	12.7	46.0	40.9	0.4	0.0
86	51.5	13.7	45.2	40.8	0.3	0.0
88	51.6	15.0	44.0	40.7	0.3	0.0
90	51.6	15.9	43.1	40.6	0.3	0.0

Egg Size Distribution *(continued)*

EGG SIZE DISTRIBUTION—E.U.STANDARDS



EGG SIZE DISTRIBUTION—U.S.STANDARDS



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

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	1.22	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	1.20	0.42	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: 2015 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[1]	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.

[1] For more information, see the "Feeding Rapeseed Meal or Canola Meal to Hy-Line Brown and Hy-Line Silver Brown Hens" Product Update at www.hyline.com.

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

Corporate Information, Technical Updates and Product Updates available at www.hyline.com

Hy-Line Brown Interactive Management Guide www.hyline.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

Understanding the Role of the Skeleton in Egg Production

The Science of Egg Quality

An Overview of Focal Duodenal Necrosis (FDN)

MG Control in Commercial Layers

Colibacillosis in Layers: An Overview

Proper Collection and Handling of Diagnostic Samples

Understanding Poultry Lighting: A Guide to LED Bulbs and Other Sources of Light for Egg Producers

Understanding Heat Stress in Layers: Management Tips to Improve Hot Weather Flock Performance

Infrared Beak Treatment

Fowl Pox in Layers

PRODUCT UPDATES

Hy-Line Brown – Selecting for Superior Egg Quality

Feeding Rapeseed Meal or Canola Meal to Hy-Line Brown and Hy-Line Silver Brown Hens

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