Hy-Line GRAY

Performance Guide

Hy-Line

Use of the Performance Guide

The genetic potential of Hy-Line Gray Commercial can only be realized if good poultry husbandry practices and management are used. This management guide outlines successful flock management programmes for Hy-Line Variety Gray 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, recognising 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.

Always consult hyline.com for the latest performance, nutrition, and management information.

Hy-Line Gray
Online Management Guide

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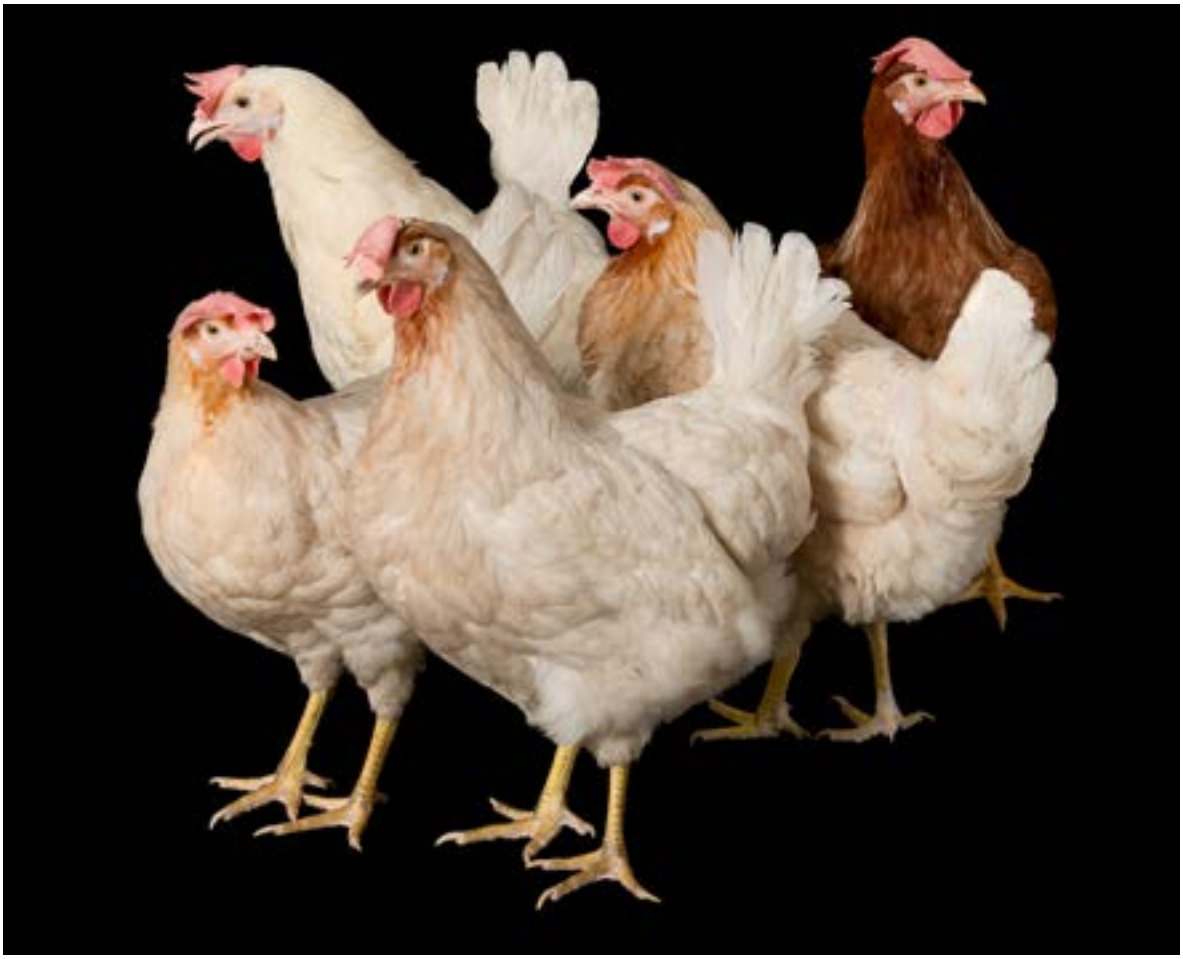
Summary of Performance Standards

REARING PERIOD (TO 17 WEEKS):	
Livability	98%
Feed Consumed	5.59–6.33 kg
Body Weight at 17 Weeks	1.46–1.48 kg
LAYING PERIOD (TO 90 WEEKS):	
Percent Peak	95–97%
Hen-Day Eggs to 60 Weeks Hen-Day Eggs to 90 Weeks	256–263 425–434
Hen-Housed Eggs to 60 Weeks Hen-Housed Eggs to 90 Weeks	254-260 416-425
Livability to 60 Weeks Livability to 90 Weeks	98% 94%
Days to 50% Production (from hatch)	143 days
Average Egg Weight at 26 Weeks Average Egg Weight at 32 Weeks Average Egg Weight at 70 Weeks	59.0–61.0 g/egg 61.2–63.2 g/egg 63.8–65.8 g/egg
Total Egg Mass per Hen-Housed (18–90 weeks)	26.6 kg
Body Weight at 32 Weeks Body Weight at 70 Weeks	1.84–1.89 kg 2.01–2.06 kg
Freedom From Egg Inclusions	Excellent
Shell Strength	Excellent
Shell Color at 38 Weeks Shell Color at 56 Weeks Shell Color at 70 Weeks	52 48 46
Haugh Units at 38 Weeks Haugh Units at 56 Weeks Haugh Units at 70 Weeks	95.0 87.0 83.0
Average Daily Feed Consumption (18–90 weeks)	101–106 g / day per bird
Feed Conversion Rate, kg Feed/kg Eggs (20–60 weeks) Feed Conversion Rate, kg Feed/kg Eggs (20–90 weeks)	1.88–1.97 1.88–1.99
Feed Utilization, kg Egg/kg Feed (20–60 weeks) Feed Utilization, kg Egg/kg Feed (20–90 weeks)	0.48–0.50 0.47–0.48
Feed Consumption per Dozen Eggs (20–60 weeks) Feed Consumption per Dozen Eggs (20–90 weeks)	1.42–1.45 kg 1.31–1.45 kg
Skin Color	Yellow
Condition of Droppings	Dry
Feather Color	Varies (see note below)

Feather color can vary from white to dark brown and in various patterns. Hy-Line does not select for feather color or feather pattern; as a consequence, a wide range in feather color and patterns is observable. See photo on p. 4.

Feather Color



The feather color of the Hy-Line Gray commercial hen varies. The birds in this photo demonstrate the acceptable range of feather color.

Rearing Period Performance Table

AGE (weeks)	MORTALITY Cumulative (%)	BODY WEIGHT (kg)	FEED INTAKE (g / bird / day)	CUMULATIVE FEED INTAKE (g to date)	WATER CONSUMP-TION (ml / bird/ day)	UNIFORMITY (Cage)
1	0.5	0.07 – 0.08	12 – 14	84 – 98	18 – 28	
2	0.7	0.11 – 0.12	18 – 22	210 – 252	27 – 44	>85%
3	0.8	0.19 – 0.20	23 – 27	371 – 441	35 – 54	
4	0.9	0.28 – 0.29	27 – 31	560 – 658	41 – 62	
5	1.0	0.38 – 0.39	31 – 35	777 – 903	47 – 70	
6	1.1	0.49 – 0.50	35 – 39	1022 – 1176	53 – 78	
7	1.2	0.59 – 0.60	39 – 43	1295 – 1477	59 – 86	
8	1.2	0.71 – 0.72	43 – 49	1596 – 1820	65 – 98	>80%
9	1.3	0.81 – 0.82	48 – 54	1932 – 2198	72 – 108	
10	1.3	0.91 – 0.92	52 – 60	2296 – 2618	78 – 120	
11	1.4	1.01 – 1.02	57 – 65	2695 – 3073	86 – 130	
12	1.5	1.11 – 1.12	62 – 70	3129 – 3563	93 – 140	
13	1.6	1.18 – 1.19	66 – 74	3591 – 4081	99 – 148	
14	1.7	1.24 – 1.25	69 – 77	4074 – 4620	104 – 154	>85%
15	1.8	1.31 – 1.32	71 – 79	4571 – 5173	107 – 158	
16	1.9	1.38 – 1.39	72 – 82	5075 – 5747	108 – 164	
17	2.0	1.44 – 1.45	73 – 83	5586 – 6328	110 – 166	>90%

Production Period Performance Table

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 (ml / bird / day)	HEN-HOUSED EGG MASS Cumulative (kg)	AVG. EGG WEIGHT (g / egg)
18	2 – 4	0.1 – 0.3	0.1 – 0.3	0.0	1.45 – 1.50	73 – 84	102 – 140	0.0	45.0
19	11 – 15	0.9 – 1.3	0.9 – 1.3	0.1	1.47 – 1.52	81 – 88	120 – 164	0.1	47.0
20	30 – 40	3.0 – 4.1	3.0 – 4.1	0.1	1.52 – 1.57	89 – 91	134 – 182	0.2	50.0
21	65 – 70	7.6 – 9.0	7.5 – 9.0	0.2	1.59 – 1.64	94 – 96	141 – 192	0.4	52.5
22	83 – 88	13.4 – 15.2	13.3 – 15.2	0.2	1.70 – 1.75	98 – 100	147 – 200	0.8	55.0
23	90 – 94	19.7 – 21.8	19.6 – 21.7	0.2	1.72 – 1.77	100 – 104	150 – 208	1.1	56.5
24	91 – 95	26.0 – 28.4	26.0 – 28.3	0.3	1.74 – 1.79	101 – 105	152 – 210	1.5	58.0
25	92 – 96	32.5 – 35.1	32.4 – 35.0	0.3	1.76 – 1.81	102 – 107	153 – 214	1.9	59.0
26	94 – 97	39.1 – 41.9	38.9 – 41.8	0.4	1.78 – 1.83	103 – 108	155 – 216	2.3	60.0
27	94 – 97	45.6 – 48.7	45.5 – 48.6	0.4	1.79 – 1.84	104 – 109	156 – 218	2.7	60.5
28	94 – 97	52.2 – 55.5	52.0 – 55.3	0.4	1.80 – 1.85	104 – 109	156 – 218	3.1	61.0
29	95 – 97	58.9 – 62.3	58.7 – 62.1	0.5	1.81 – 1.86	104 – 109	156 – 218	3.5	61.5
30	95 – 97	65.5 – 69.1	65.3 – 68.8	0.5	1.82 – 1.87	104 – 109	156 – 218	3.9	61.7
31	94 – 97	72.1 – 75.9	71.8 – 75.6	0.6	1.83 – 1.88	104 – 109	156 – 218	4.3	62.0
32	94 – 96	78.7 – 82.6	78.4 – 82.3	0.6	1.84 – 1.89	104 – 109	156 – 218	4.7	62.2
33	94 – 96	85.3 – 89.3	84.9 – 88.9	0.6	1.85 – 1.90	104 – 109	156 – 218	5.1	62.4
34	94 – 96	91.8 – 96.0	91.4 – 95.6	0.7	1.86 – 1.91	104 – 109	156 – 218	5.6	62.6
35	94 – 95	98.4 – 102.7	97.9 – 102.2	0.7	1.86 – 1.91	104 – 109	156 – 218	6.0	62.8
36	94 – 95	105.0 – 109.3	104.5 – 108.8	0.8	1.87 – 1.92	104 – 109	156 – 218	6.4	63.0
37	93 – 95	111.5 – 116.0	110.9 – 115.4	0.8	1.87 – 1.92	104 – 109	156 – 218	6.8	63.2
38	93 – 95	118.0 – 122.6	117.4 – 122.0	0.9	1.88 – 1.93	104 – 109	156 – 218	7.2	63.3
39	93 – 94	124.5 – 129.2	123.8 – 128.5	0.9	1.89 – 1.94	104 – 109	156 – 218	7.6	63.4
40	93 – 94	131.0 – 135.8	130.3 – 135.0	1.0	1.90 – 1.95	104 – 109	156 – 218	8.0	63.5
41	92 – 94	137.5 – 142.4	136.6 – 141.5	1.0	1.91 – 1.96	103 – 108	155 – 216	8.4	63.6
42	92 – 94	143.9 – 149.0	143.0 – 148.0	1.1	1.92 – 1.97	103 – 108	155 – 216	8.8	63.7
43	92 – 94	150.4 – 155.5	149.4 – 154.5	1.1	1.93 – 1.98	103 – 108	155 – 216	9.3	63.8
44	92 – 94	156.8 – 162.1	155.7 – 161.0	1.2	1.94 – 1.99	103 – 108	155 – 216	9.7	63.9
45	91 – 93	163.2 – 168.6	162.0 – 167.5	1.2	1.95 – 2.00	103 – 108	155 – 216	10.1	64.0
46	91 – 93	169.5 – 175.1	168.3 – 173.9	1.3	1.96 – 2.01	103 – 108	155 – 216	10.5	64.1
47	91 – 93	175.9 – 181.7	174.6 – 180.3	1.3	1.97 – 2.02	102 – 108	153 – 216	10.9	64.2
48	90 – 91	182.2 – 188.0	180.8 – 186.6	1.4	1.98 – 2.03	102 – 108	153 – 216	11.3	64.3
49	90 – 91	188.5 – 194.4	187.0 – 192.9	1.4	1.99 – 2.04	102 – 108	153 – 216	11.7	64.4
50	90 – 91	194.8 – 200.8	193.2 – 199.1	1.5	1.99 – 2.04	102 – 108	153 – 216	12.1	64.5

Production Period Performance Table (cont.)

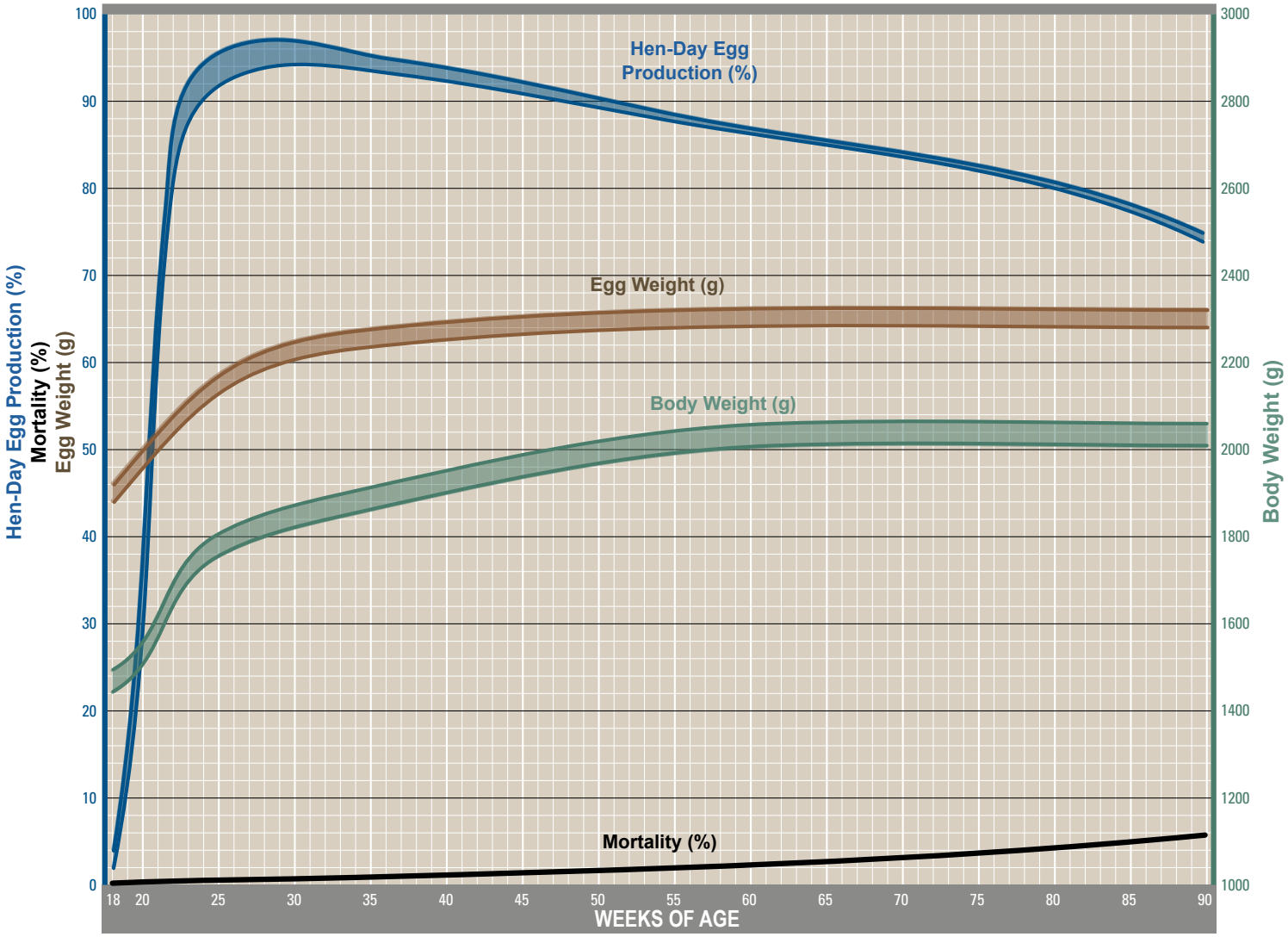
AGE (weeks)	% HEN-DAY Current	HEN-DAY EGGS Cumulative	HEN-HOUSED EGGS Cumulative	MORT-ALITY Cumulative (%)	BODY WEIGHT (kg)	FEED INTAKE (g / bird / day)	WATER CONSUMP-TION (ml / bird / day)	HEN-HOUSED EGG MASS Cumulative (kg)	AVG. EGG WEIGHT (g / egg)
51	89 – 90	201.0 – 207.1	199.4 – 205.3	1.5	1.99 – 2.04	102 – 108	153 – 216	12.5	64.5
52	89 – 90	207.3 – 213.4	205.5 – 211.5	1.6	1.99 – 2.04	102 – 108	153 – 216	12.9	64.5
53	89 – 90	213.5 – 219.7	211.6 – 217.7	1.7	1.99 – 2.04	102 – 108	153 – 216	13.3	64.5
54	88 – 89	219.7 – 225.9	217.7 – 223.8	1.8	1.99 – 2.04	102 – 108	153 – 216	13.7	64.5
55	88 – 89	225.8 – 232.1	223.7 – 230.0	1.8	1.99 – 2.04	102 – 108	153 – 216	14.1	64.5
56	88 – 89	232.0 – 238.4	229.7 – 236.1	1.9	2.00 – 2.05	102 – 108	153 – 216	14.5	64.6
57	87 – 88	238.1 – 244.5	235.7 – 242.1	2.0	2.00 – 2.05	102 – 108	153 – 216	14.9	64.6
58	87 – 88	244.2 – 250.7	241.7 – 248.1	2.0	2.00 – 2.05	102 – 108	153 – 216	15.2	64.6
59	87 – 88	250.3 – 256.8	247.6 – 254.2	2.1	2.00 – 2.05	102 – 108	153 – 216	15.6	64.6
60	86 – 87	256.3 – 262.9	253.5 – 260.1	2.2	2.01 – 2.06	102 – 108	153 – 216	16.0	64.6
61	86 – 87	262.3 – 269.0	259.4 – 266.1	2.3	2.01 – 2.06	101 – 107	152 – 214	16.4	64.7
62	86 – 87	268.3 – 275.1	265.3 – 272.0	2.4	2.01 – 2.06	101 – 107	152 – 214	16.8	64.7
63	85 – 86	274.3 – 281.1	271.1 – 277.9	2.4	2.01 – 2.06	101 – 107	152 – 214	17.2	64.7
64	85 – 86	280.2 – 287.1	276.9 – 283.8	2.5	2.01 – 2.06	101 – 107	152 – 214	17.5	64.7
65	85 – 86	286.2 – 293.2	282.7 – 289.6	2.6	2.01 – 2.06	101 – 107	152 – 214	17.9	64.7
66	84 – 85	292.0 – 299.1	288.4 – 295.4	2.7	2.01 – 2.06	101 – 107	152 – 214	18.3	64.8
67	84 – 85	297.9 – 305.1	294.1 – 301.2	2.8	2.01 – 2.06	101 – 107	152 – 214	18.7	64.8
68	84 – 85	303.8 – 311.0	299.8 – 306.9	3.0	2.01 – 2.06	101 – 107	152 – 214	19.0	64.8
69	83 – 84	309.6 – 316.9	305.4 – 312.6	3.1	2.01 – 2.06	101 – 107	152 – 214	19.4	64.8
70	83 – 84	315.4 – 322.8	311.1 – 318.3	3.2	2.01 – 2.06	101 – 107	152 – 214	19.8	64.8
71	83 – 84	321.2 – 328.7	316.7 – 324.0	3.3	2.01 – 2.06	100 – 107	150 – 214	20.1	64.9
72	82 – 83	327.0 – 334.5	322.2 – 329.6	3.4	2.01 – 2.06	100 – 107	150 – 214	20.5	64.9
73	82 – 83	332.7 – 340.3	327.7 – 335.2	3.5	2.01 – 2.06	100 – 107	150 – 214	20.9	64.9
74	82 – 83	338.5 – 346.1	333.3 – 340.8	3.7	2.01 – 2.06	100 – 107	150 – 214	21.2	64.9
75	81 – 82	344.1 – 351.8	338.7 – 346.3	3.8	2.01 – 2.06	100 – 107	150 – 214	21.6	64.9
76	81 – 82	349.8 – 357.6	344.2 – 351.9	3.9	2.01 – 2.06	100 – 107	150 – 214	21.9	64.9
77	81 – 82	355.5 – 363.3	349.6 – 357.4	4.0	2.01 – 2.06	100 – 107	150 – 214	22.3	64.9
78	80 – 81	361.1 – 369.0	355.0 – 362.8	4.2	2.01 – 2.06	100 – 107	150 – 214	22.6	64.9
79	80 – 81	366.7 – 374.6	360.3 – 368.2	4.3	2.01 – 2.06	100 – 107	150 – 214	23.0	64.9
80	79 – 80	372.2 – 380.2	365.6 – 373.6	4.4	2.01 – 2.06	100 – 107	150 – 214	23.3	65.0
81	79 – 80	377.7 – 385.8	370.9 – 378.9	4.6	2.01 – 2.06	99 – 106	149 – 212	23.7	65.0
82	78 – 79	383.2 – 391.4	376.1 – 384.2	4.7	2.01 – 2.06	99 – 106	149 – 212	24.0	65.0
83	78 – 79	388.6 – 396.9	381.3 – 389.4	4.8	2.01 – 2.06	99 – 106	149 – 212	24.3	65.0
84	77 – 78	394.0 – 402.4	386.4 – 394.6	5.0	2.01 – 2.06	99 – 106	149 – 212	24.7	65.0
85	77 – 78	399.4 – 407.8	391.5 – 399.8	5.1	2.01 – 2.06	99 – 106	149 – 212	25.0	65.0
86	76 – 77	404.7 – 413.2	396.6 – 404.9	5.3	2.01 – 2.06	99 – 106	149 – 212	25.3	65.0
87	76 – 77	410.1 – 418.6	401.6 – 410.0	5.4	2.01 – 2.06	99 – 106	149 – 212	25.7	65.0
88	75 – 76	415.3 – 423.9	406.5 – 415.0	5.6	2.01 – 2.06	99 – 106	149 – 212	26.0	65.0
89	75 – 76	420.6 – 429.2	411.5 – 420.0	5.7	2.01 – 2.06	99 – 106	149 – 212	26.3	65.0
90	74 – 75	425.7 – 434.5	416.4 – 425.0	5.9	2.01 – 2.06	99 – 106	149 – 212	26.6	65.0

Production Period Space Recommendations

check local regulations concerning space requirements)

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

Performance Graph



Egg Quality and Egg Size Distribution

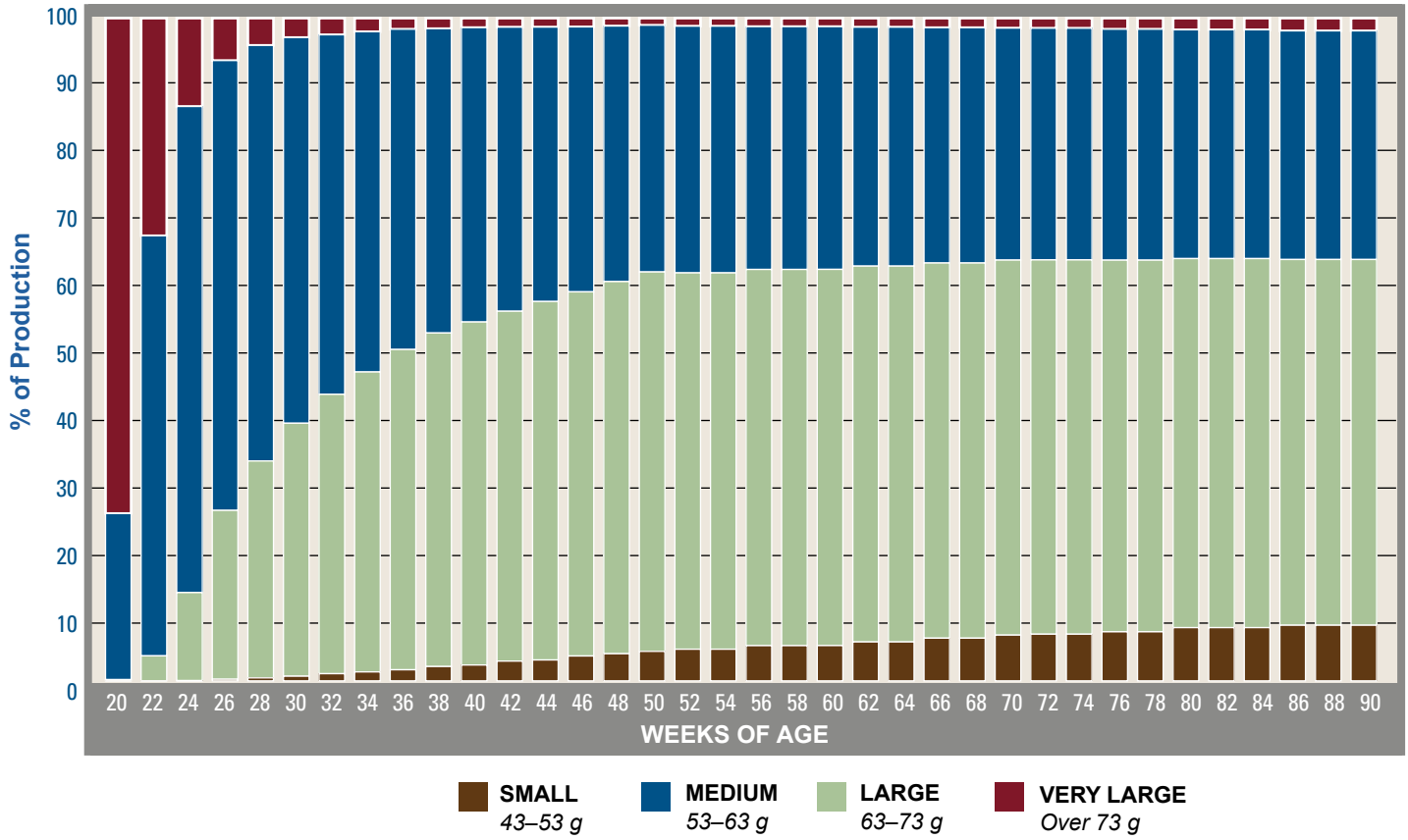
EGG QUALITY			
AGE (weeks)	HAUGH UNITS	BREAKING STRENGTH	SHELL COLOR
20	99.7	4605	52
22	98.8	4590	53
24	98.0	4580	54
26	97.2	4570	54
28	96.4	4560	53
30	95.6	4540	52
32	94.8	4515	52
34	94.1	4490	52
36	93.3	4450	51
38	92.6	4425	51
40	91.8	4405	51
42	91.1	4375	51
44	90.4	4355	51
46	89.7	4320	50
48	89.0	4305	50
50	88.4	4280	50
52	87.8	4250	49
54	87.1	4225	49
56	86.5	4190	48
58	86.0	4170	48
60	85.4	4150	48
62	84.9	4130	47
64	84.4	4110	47
66	83.8	4095	46
68	83.3	4085	46
70	82.8	4075	46
72	82.4	4065	45
74	81.9	4055	45
76	81.5	4040	44
78	81.1	4020	44
80	80.7	3995	44
82	80.3	3985	43
84	79.9	3975	43
86	79.5	3965	42
88	79.1	3960	42
90	78.7	3955	42

E.U. Standards

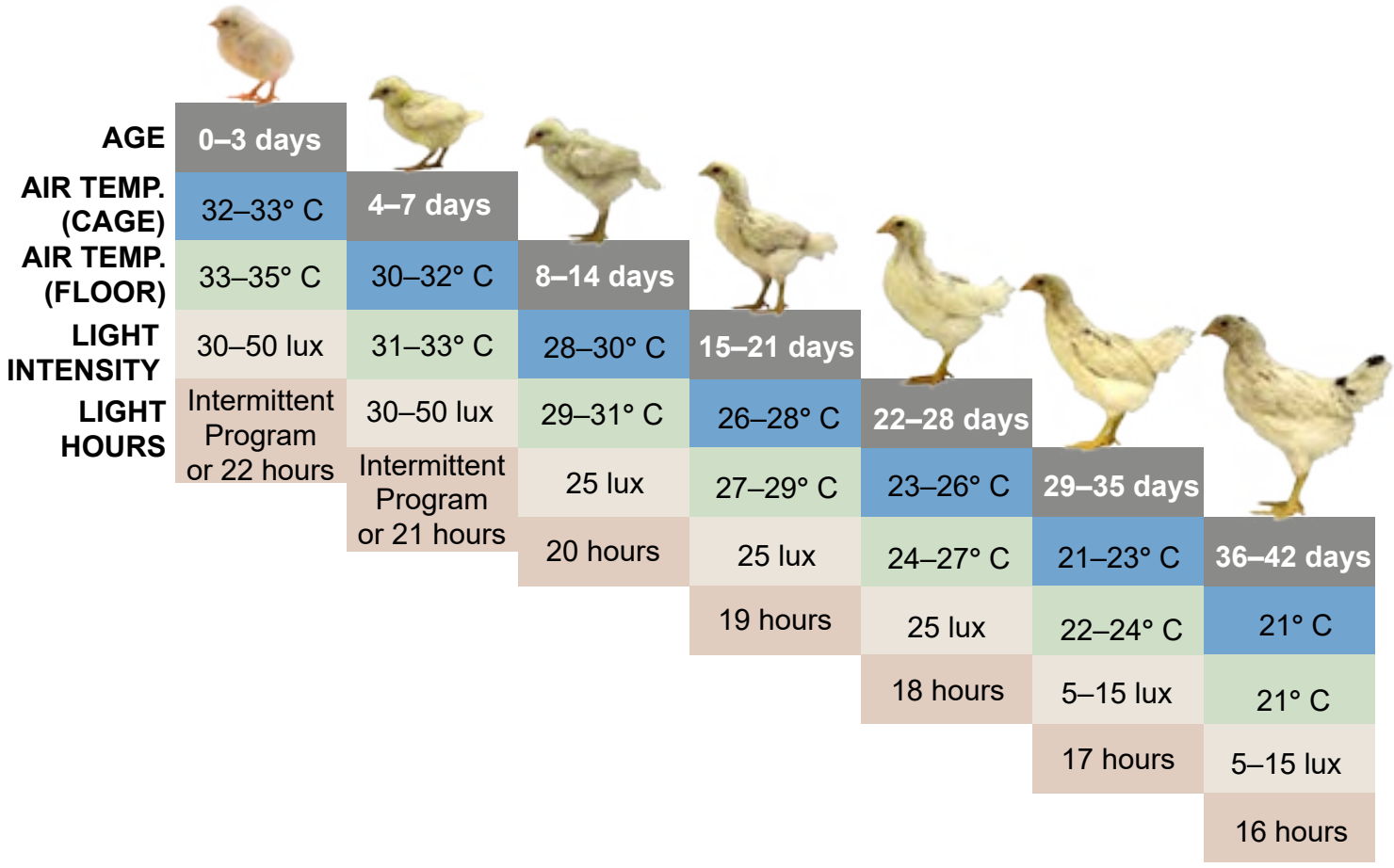
EGG SIZE DISTRIBUTION—E.U. STANDARDS					
AGE (weeks)	AVERAGE EGG WEIGHT (g)	% VERY LARGE Over 73 g	% LARGE 63–73 g	% MEDIUM 53–63 g	% SMALL 43–53 g
20	50.0	0.00	0.19	25.06	74.75
22	55.0	0.00	3.77	63.39	32.84
24	58.0	0.04	13.28	73.35	13.33
26	60.0	0.24	25.48	67.88	6.40
28	61.0	0.45	32.73	62.71	4.11
30	61.7	0.70	38.17	58.20	2.93
32	62.2	1.08	42.16	54.25	2.51
34	62.6	1.35	45.26	51.34	2.05
36	63.0	1.67	48.33	48.33	1.67
38	63.3	2.16	50.33	45.92	1.59
40	63.5	2.39	51.76	44.42	1.43
42	63.7	2.98	52.79	42.87	1.36
44	63.9	3.15	54.09	41.41	1.35
46	64.1	3.75	54.95	39.98	1.32
48	64.3	4.09	56.16	38.56	1.19
50	64.5	4.45	57.25	37.23	1.07
52	64.5	4.77	56.79	37.23	1.21
54	64.5	4.77	56.79	37.23	1.21
56	64.6	5.31	56.77	36.64	1.28
58	64.6	5.31	56.77	36.64	1.28
60	64.6	5.32	56.77	36.63	1.28
62	64.7	5.87	56.71	36.06	1.36
64	64.7	5.87	56.71	36.06	1.36
66	64.8	6.44	56.61	35.51	1.44
68	64.8	6.44	56.61	35.51	1.44
70	64.8	6.90	56.59	35.01	1.50
72	64.9	7.04	56.48	34.96	1.52
74	64.9	7.04	56.48	34.96	1.52
76	64.9	7.40	56.08	34.85	1.67
78	64.9	7.40	56.08	34.85	1.67
80	65.0	8.03	55.69	34.52	1.76
82	65.0	8.03	55.69	34.52	1.76
84	65.0	8.03	55.69	34.52	1.76
86	65.0	8.39	55.19	34.50	1.92
88	65.0	8.39	55.19	34.50	1.92
90	65.0	8.39	55.19	34.50	1.92

Egg Size Distribution (cont.)

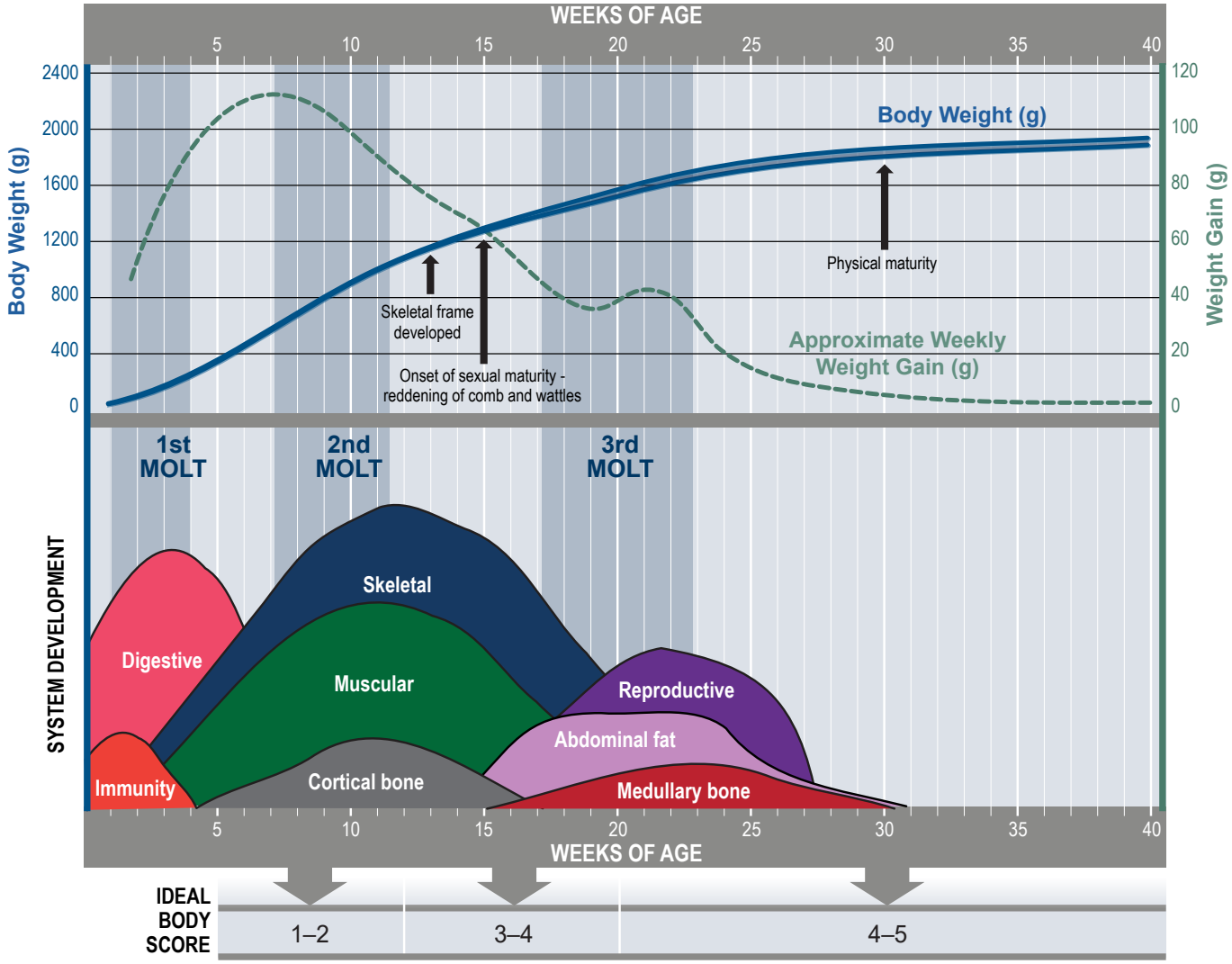
E.U. Standards



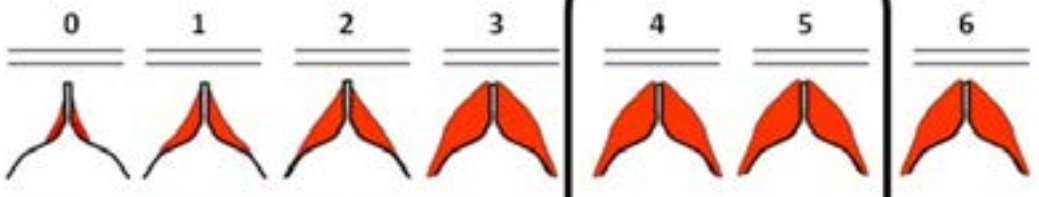
Brooding Temperature and Lighting Recommendations



Development of the Organ Systems in Pullets

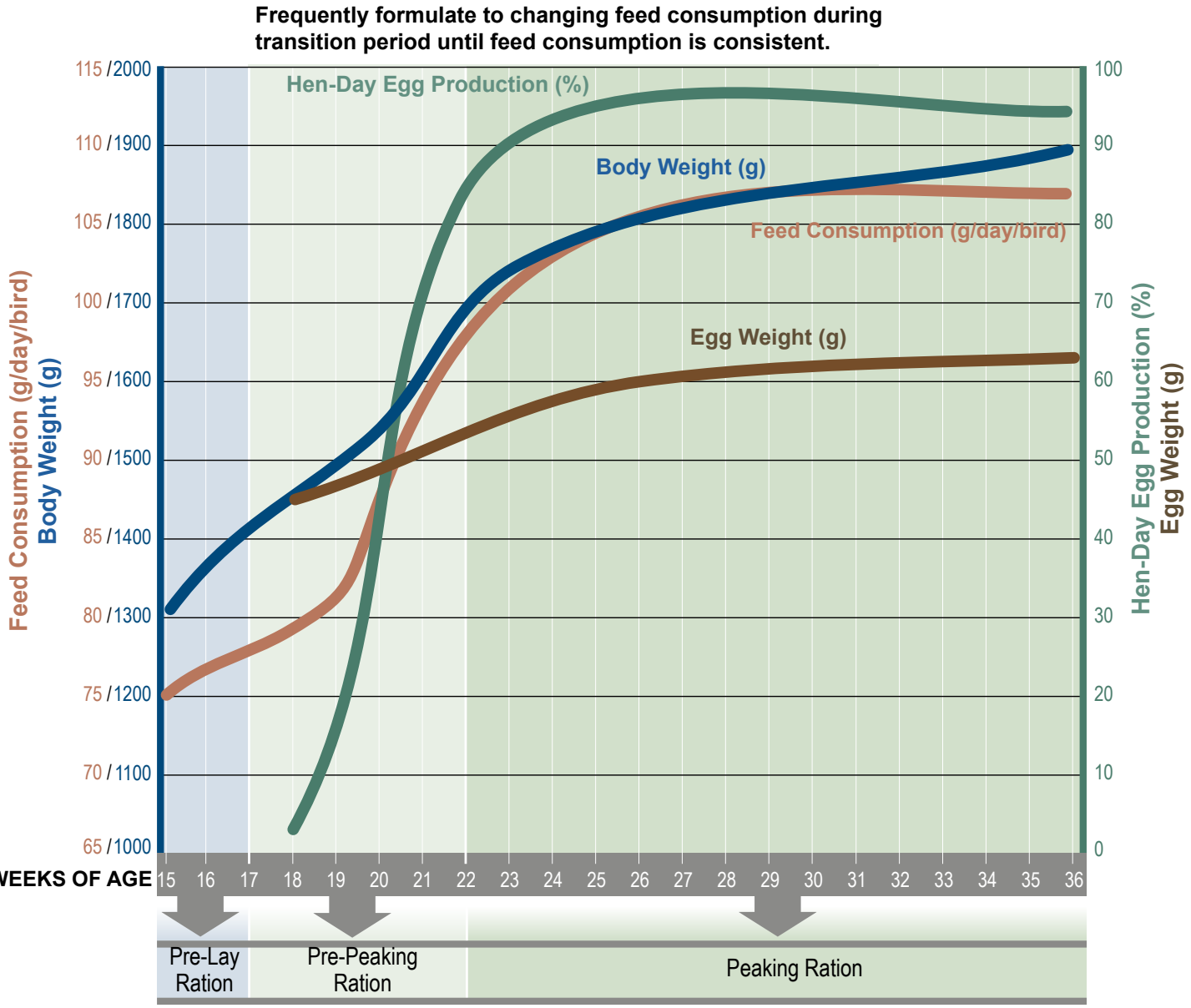


Body Score Chart



	0	1	2	3	4	5	6
Sternum (Keel)							
Abdominal Fat	None	None	None	None	< 0.7 cm	> 0.7 cm	Large fat pad
Comments	Emaciated birds	Low level of breast flesh concave in shape	Moderate breast flesh pyramid in shape	Well fleshed breast convex in shape	Abdominal fat pad small; Breast convex in shape	Abdominal fat pad increasing in size; Breast convex in shape	Pendulous fat pad; Breast convex in shape

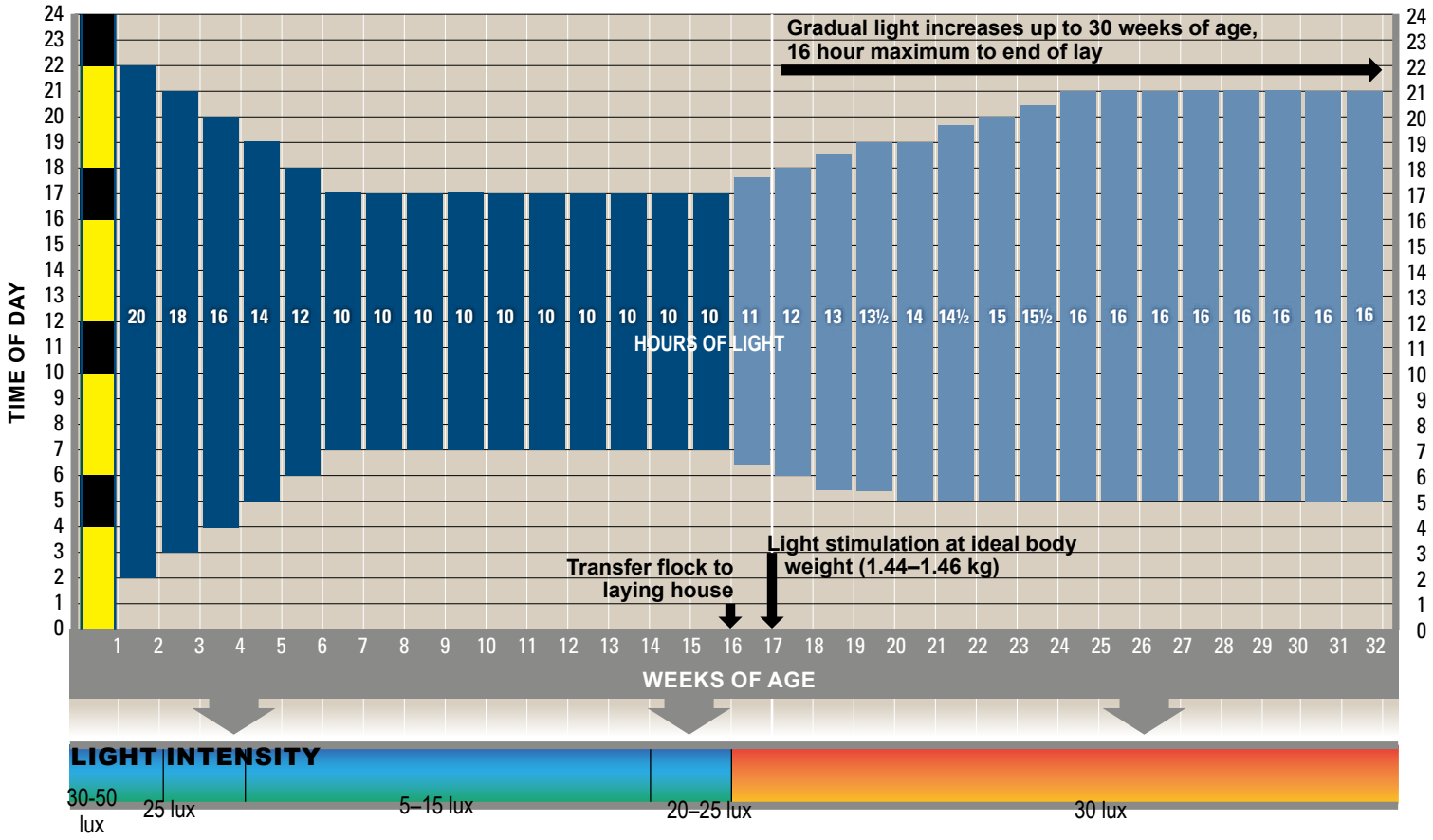
Transition Period from Rear to Peak Egg Production



Pre-Peak

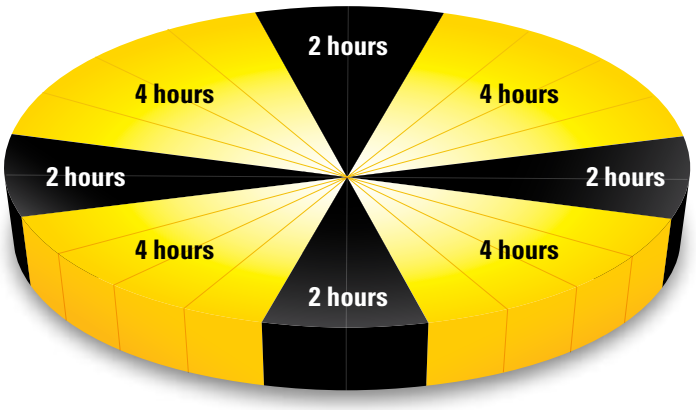
- Pre-Peak diets are intended for flocks with low feed intake and are fed for a limited period from first egg to the beginning of peak production. The nutrient specification of the Pre-Peak diet should be dense enough to allow for lower feed intake and also cater to the increased nutritional needs of the bird entering egg production. Continue to feed the Pre-Peak until feed intake has developed sufficiently to allow transition to the Peak diet.
- If utilized until no more than 50–70% HD, a Pre-Peak diet with reduced energy concentration can be beneficial to stimulate feed intake. Pre-Peaking diets are useful in situations where local conditions may result in reduced feed intake, such as hot climates where feed intake may be depressed.
- Increasing the vitamins and trace mineral inclusion to 30% can be useful to cope with the lower feed intake during the Pre-Peak phase.

Light Program for Light-Controlled Housing

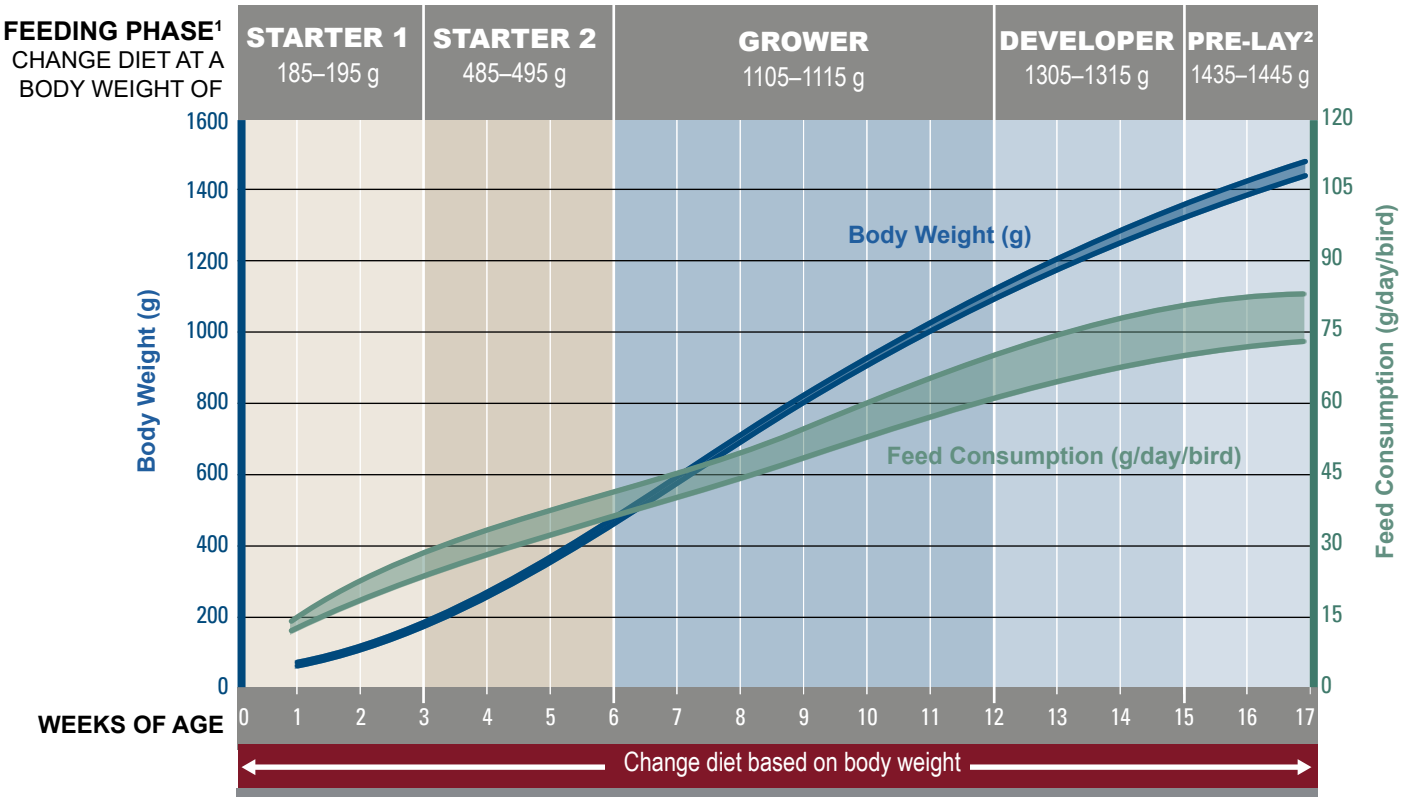


Intermittent Lighting Program for Chicks

- 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.
- Synchronises chicks' activities and feedings.
- Establishes more natural behaviour of rest and activity.
- May improve 7-day livability and pullet body weight.
- Some dark periods may be shortened or removed to accommodate work schedules.



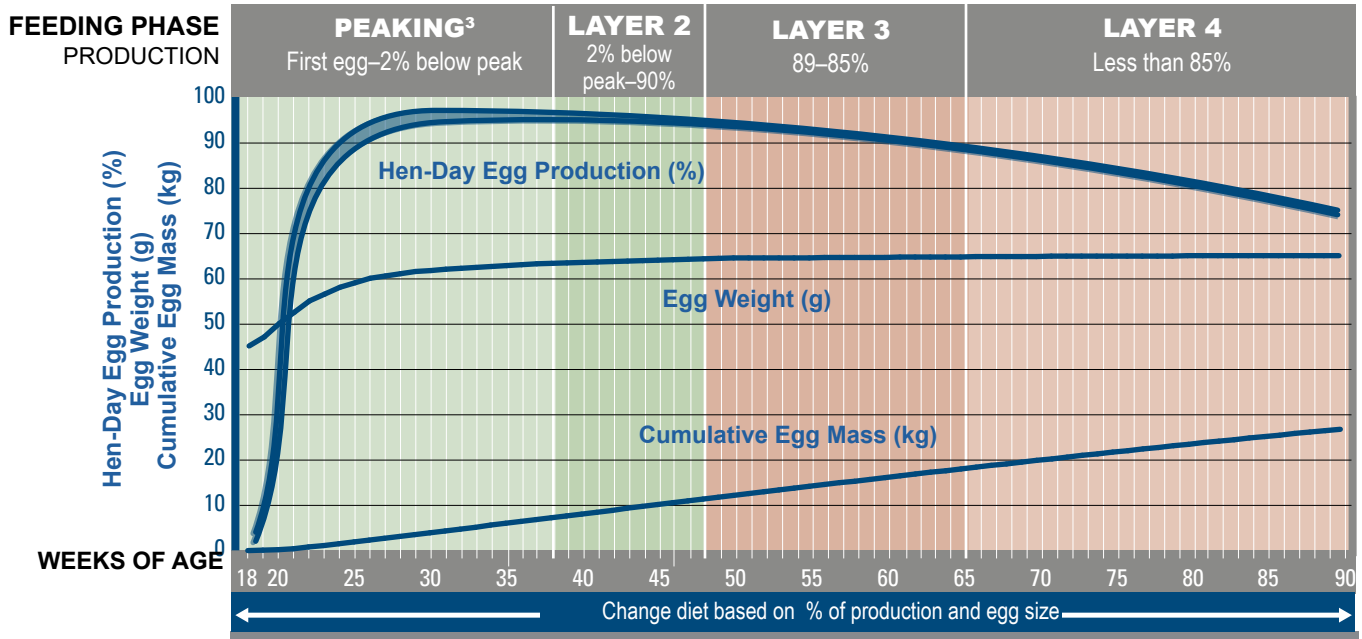
Rearing Period Nutritional Recommendations



NUTRITION	RECOMMENDED NUTRIENT CONCENTRATION				
Metabolizable energy[3], kcal/kg	2756–2999	2756–2999	2734–2999	2734–2999	2734–2999
Metabolizable energy[3], MJ/kg	11.54–12.55	11.54–12.55	11.54–12.55	11.54–12.55	11.54–12.55
	Standardized Ileal Digestible Amino Acids / Total Amino Acids[4]				
Lysine, %	1.00 / 1.09	0.91 / 1.00	0.82 / 0.90	0.69 / 0.76	0.73 / 0.80
Methionine, %	0.45 / 0.48	0.41 / 0.44	0.38 / 0.41	0.32 / 0.35	0.34 / 0.37
Methionine+Cystine,%	0.73 / 0.82	0.68 / 0.77	0.64 / 0.72	0.57 / 0.65	0.60 / 0.68
Threonine, %	0.66 / 0.78	0.61 / 0.72	0.56 / 0.66	0.48 / 0.56	0.51 / 0.60
Tryptophan, %	0.17 / 0.20	0.16 / 0.20	0.16 / 0.19	0.14 / 0.16	0.15 / 0.18
Arginine, %	1.07 / 1.15	0.97 / 1.05	0.88 / 0.94	0.74 / 0.79	0.78 / 0.84
Isoleucine, %	0.70 / 0.75	0.66 / 0.70	0.61 / 0.65	0.52 / 0.56	0.58 / 0.63
Valine, %	0.72 / 0.79	0.67 / 0.74	0.64 / 0.71	0.55 / 0.61	0.62 / 0.68
Crude protein[5], %	20.00	18.25	17.50	16.00	16.50
Calcium[6], %	1.05	1.00	0.95	0.90	2.50
Phosphorus (available)[7], %	0.48	0.47	0.45	0.40	0.43
Phosphorus (digestible), %	0.44	0.43	0.41	0.35	0.38
Sodium, %	0.18	0.18	0.18	0.18	0.18
Chloride, %	0.18	0.18	0.18	0.18	0.18
Linoleic acid (C18:2 n-6), %	1.00	1.00	1.00	1.00	1.00

[1] Body weights are approximate. Ages shown are a guide only. Please note that at time of transfer, there will be some loss in body weight (normally 10–12%) due to reduced water intake.
[2] 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.
[3] 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.
[4] Recommendation for Total Amino Acids is only appropriate to corn and soybean meal diet. Where diets utilise other ingredients, recommendations for Standardised Ileal Digestible Amino Acids must be followed.
[5] Diets should always be formulated to provide required intake of amino acid. Concentration of crude protein in diet will vary with raw material used. Crude protein value provided is an estimated typical value only.
[6] Calcium 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.
[7] Where other phosphorus systems are used, diets should contain recommended minimum level of available phosphorus.

Production Period Nutritional Recommendations[1,2]



NUTRITION	RECOMMENDED DAILY NUTRIENT INTAKE			
Metabolizable energy[4], kcal/kg	2778–2867	2756–2867	2701–2867	2701–2867
Metabolizable energy[4], MJ/kg	11.63–12.00	11.54–12.00	11.31–12.00	11.31–12.00
	Standardized Ileal Digestible Amino Acids / Total Amino Acids[5]			
Lysine, mg/day	810 / 887	775 / 849	740 / 810	705 / 772
Methionine, mg/day	397 / 427	357 / 383	340 / 366	317 / 341
Methionine+Cystine, mg/day	664 / 749	605 / 682	570 / 643	529 / 596
Threonine, mg/day	567 / 667	543 / 638	518 / 609	494 / 581
Tryptophan, mg/day	170 / 203	163 / 195	155 / 186	148 / 177
Arginine, mg/day	867 / 932	829 / 892	792 / 851	754 / 811
Isoleucine, mg/day	640 / 688	612 / 658	585 / 629	557 / 599
Valine, mg/day	729 / 804	698 / 769	666 / 735	635 / 700
Crude protein[6], g/day	17.50	17.00	16.00	15.00
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 AND PHOSPHORUS			
	Calcium[7,8] g/day	Phosphorus (available)[7,9] mg/day	Phosphorus (digestible) mg/day	Calcium Particle Size (fine : coarse)
Weeks 18–32	4.00	447	401	40% : 60%
Weeks 33–55	4.15	421	381	35% : 65%
Weeks 56–72	4.30	395	356	30% : 70%
Weeks 73–85	4.45	369	334	25% : 75%
Weeks 86+	4.60	344	309	25% : 75%

	IDEAL PROTEIN REFERENCE			
	PEAKING	PHASE 2	PHASE 3	PHASE 4
Lysine	100%	100%	100%	100%
Methionine	49%	46%	46%	45%
M+C	82%	78%	77%	75%
Threonine	70%	70%	70%	70%
Tryptophan	21%	21%	21%	21%
Arginine	107%	107%	107%	107%
Isoleucine	79%	79%	79%	79%
Valine	90%	90%	90%	90%

Production Period Dietary Nutrient Concentrations[1,2]

FEEDING PHASE / PRODUCTION	PEAKING[3] First egg until production drops 2% below peak					LAYER 2 2% below peak to 90%					LAYER 3 89–85%					LAYER 4 Less than 85%				
NUTRITION	**RECOMMENDED CONCENTRATION**																			
Metabolizable energy[4], kcal/kg	2778–2867					2756–2867					2701–2867					2701–2867				
Metabolizable energy[4], MJ/kg	11.63–12.00					11.54–12.00					11.31–12.00					11.31–12.00				
FEED CONSUMPTION (*Typical Feed Consumption)																				
g/day per bird	90	95	100*	105	110	100	105	110*	115	120	100	105	110*	115	120	100	105	110*	115	120
Standardized Ileal Digestible Amino Acids																				
Lysine, %	0.90	0.85	0.81	0.77	0.74	0.78	0.74	0.70	0.67	0.65	0.74	0.70	0.67	0.64	0.62	0.71	0.67	0.64	0.61	0.59
Methionine, %	0.44	0.42	0.40	0.38	0.36	0.36	0.34	0.32	0.31	0.30	0.34	0.32	0.31	0.30	0.28	0.32	0.30	0.29	0.28	0.26
Methionine+Cystine,%	0.74	0.70	0.66	0.63	0.60	0.61	0.58	0.55	0.53	0.50	0.57	0.54	0.52	0.50	0.48	0.53	0.50	0.48	0.46	0.44
Threonine, %	0.63	0.60	0.57	0.54	0.52	0.54	0.52	0.49	0.47	0.45	0.52	0.49	0.47	0.45	0.43	0.49	0.47	0.45	0.43	0.41
Tryptophan, %	0.19	0.18	0.17	0.16	0.15	0.16	0.16	0.15	0.14	0.14	0.16	0.15	0.14	0.13	0.13	0.15	0.14	0.13	0.13	0.12
Arginine, %	0.96	0.91	0.87	0.83	0.79	0.83	0.79	0.75	0.72	0.69	0.79	0.75	0.72	0.69	0.66	0.75	0.72	0.69	0.66	0.63
Isoleucine, %	0.71	0.67	0.64	0.61	0.58	0.61	0.58	0.56	0.53	0.51	0.59	0.56	0.53	0.51	0.49	0.56	0.53	0.51	0.48	0.46
Valine, %	0.81	0.77	0.73	0.69	0.66	0.70	0.66	0.63	0.61	0.58	0.67	0.63	0.61	0.58	0.56	0.64	0.60	0.58	0.55	0.53
Total Amino Acids[5]																				
Lysine, %	0.99	0.93	0.89	0.84	0.81	0.85	0.81	0.77	0.74	0.71	0.81	0.77	0.74	0.70	0.68	0.77	0.74	0.70	0.67	0.64
Methionine, %	0.47	0.45	0.43	0.41	0.39	0.38	0.36	0.35	0.33	0.32	0.37	0.35	0.33	0.32	0.31	0.34	0.32	0.31	0.30	0.28
Methionine+Cystine,%	0.83	0.79	0.75	0.71	0.68	0.68	0.65	0.62	0.59	0.57	0.64	0.61	0.58	0.56	0.54	0.60	0.57	0.54	0.52	0.50
Threonine, %	0.74	0.70	0.67	0.64	0.61	0.64	0.61	0.58	0.55	0.53	0.61	0.58	0.55	0.53	0.51	0.58	0.55	0.53	0.51	0.48
Tryptophan, %	0.23	0.21	0.20	0.19	0.18	0.20	0.19	0.18	0.17	0.16	0.19	0.18	0.17	0.16	0.16	0.18	0.17	0.16	0.15	0.15
Arginine, %	1.04	0.98	0.93	0.89	0.85	0.89	0.85	0.81	0.78	0.74	0.85	0.81	0.77	0.74	0.71	0.81	0.77	0.74	0.71	0.68
Isoleucine, %	0.76	0.72	0.69	0.66	0.63	0.66	0.63	0.60	0.57	0.55	0.63	0.60	0.57	0.55	0.52	0.60	0.57	0.54	0.52	0.50
Valine, %	0.89	0.85	0.80	0.77	0.73	0.77	0.73	0.70	0.67	0.64	0.74	0.70	0.67	0.64	0.61	0.70	0.67	0.64	0.61	0.58
Crude protein[6], %	19.44	18.42	17.50	16.67	15.91	17.00	16.19	15.45	14.78	14.17	16.00	15.24	14.55	13.91	13.33	15.00	14.29	13.64	13.04	12.50
Sodium, %	0.20	0.19	0.18	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	0.16	0.16	0.15
Chloride, %	0.20	0.19	0.18	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	0.16	0.16	0.15
Linoleic acid (C18:2 n-6), %	1.11	1.05	1.00	0.95	0.91	1.00	0.95	0.91	0.87	0.83	1.00	0.95	0.91	0.87	0.83	1.00	0.95	0.91	0.87	0.83

CALCIUM AND PHOSPHORUS CHANGES BASED ON FEED INTAKE																										
	Weeks 18–32							Weeks 33–55					Weeks 56–72					Weeks 73–85					Weeks 86+				
Feed Consumption, g/day per bird	85	90	95	**100**	105	110	115	95	100	**105**	110	115	95	100	**105**	110	115	95	100	**105**	110	115	95	100	**105**	110	115
Calcium[7,8], %	4.71	4.44	4.21	**4.00**	3.81	3.64	3.48	4.37	4.15	**3.95**	3.77	3.61	4.53	4.30	**4.10**	3.91	3.74	4.68	4.45	**4.24**	4.05	3.87	4.84	4.60	**4.38**	4.18	4.00
Phosphorus (available)[7,9], %	0.53	0.50	0.47	**0.45**	0.43	0.41	0.39	0.44	0.42	**0.40**	0.38	0.37	0.42	0.39	**0.38**	0.36	0.34	0.39	0.37	**0.35**	0.34	0.32	0.36	0.34	**0.33**	0.31	0.30
Phosphorus (digestible), %	0.47	0.45	0.42	**0.40**	0.38	0.36	0.35	0.40	0.38	**0.36**	0.35	0.33	0.38	0.36	**0.34**	0.32	0.31	0.35	0.33	**0.32**	0.30	0.29	0.33	0.31	**0.29**	0.28	0.27

[1] All nutrient requirements are based on the Feed Ingredient Tables.
[2] Crude protein, methionine+cystine, fat, linoleic acid, and / or energy may be changed to optimize egg size.
[3] Peaking nutrient levels are calculated for birds at peak egg production. Prior to achieving peak egg production, the nutrient requirements will be lower.
[4] A good approximation of the influence of temperature on energy needs is that for each 0.5°C change higher or lower than 22°C, subtract or add about 2 kcal /bird /day, respectively.
[5] 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.
[6] 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.
[7] 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.
[8] Calcium carbonate particle size recommendation varies throughout lay. Refer to Calcium Particle Size. Dietary calcium levels and fine to coarse ratio may need to be adjusted based on limestone solubility.
[9] Where other phosphorus systems are used, diets should contain recommended minimum level of available phosphorus.

Vitamins and Trace Minerals

ITEM [1,2,3,4]	IN 1000 KG COMPLETE DIET	
	Rearing Period	Production Period
Vitamin A, IU	10,000,000	8,000,000
Vitamin D_3[5], IU	3,300,000	3,300,000
Vitamin E, g	30.00	25.00
Vitamin K (menadione), g	3.50	3.00
Thiamin (B_1), g	2.20	2.50
Riboflavin (B_2), g	6.60	5.50
Niacin (B_3)[6], g	40.00	30.00
Pantothenic acid (B_5), g	10.00	10.00
Pyridoxine (B_6), g	4.50	5.00
Biotin (B_7), mg	100.00	75.00
Folic acid (B_9), g	1.00	0.90
Cobalamine (B_{12}), mg	23.00	23.00
Manganese[7], g	100.00	100.00
Zinc[7], g	85.00	80.00
Iron[7], g	30.00	40.00
Copper[7], g	15.00	8.00
Magnesium[7], g	600.00	500.00
Iodine, g	1.50	1.20
Selenium[7], g	0.25	0.25

[1] Minimum recommendations for rearing and laying periods. Local regulations may limit dietary content of individual vitamins or minerals. Levels of 150-200mg/kg of Vitamin C can be beneficial during periods of stress.

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

Drinking Water Quality for Poultry

ITEM	MAXIMUM CONCENTRATION (ppm or mg/L)*	
Nitrate NO_3^- [1]	25	Older birds will tolerate higher levels up to 20 ppm. Stressed or disease 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.
Sulphate (SO_4^-) [1]	250	Higher levels may be laxative.
Iron (Fe) [1]	<0.3	Higher levels result in bad odour 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	
Aluminium (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]	5–7	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	
Faecal 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 sanitise water at a favourable 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

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Diseases

An Overview of Focal Duodenal Necrosis (FDN)
MG Control in Commercial Layers
Colibacillosis in Layers: An Overview
Fowl Pox in Layers
Avian Urolithiasis (Visceral Gout)
Infectious Bursal Disease (IBD, Gumboro)
Fatty Liver Hemorrhagic Syndrome
Infectious Laryngotracheitis (ILT)
Intestinal Dilation Syndrome (IDS)
Newcastle Disease
Mycoplasma Synoviae (MS)
Low Pathogenic Avian Influenza (LPAI)

Diagnostic Samples and Breeder Flock Monitoring

Salmonella, *Mycoplasma*, and Avian Influenza Monitoring in Parent Breeder Flocks
Proper Collection and Handling of Diagnostic Samples

Management

Growing Management of Commercial Pullets
Understanding the Role of the Skeleton in Egg Production
The Science of Egg Quality
Understanding Poultry Lighting
Understanding Heat Stress in Layers
Infrared Beak Treatment
Feed Granulometry and the Importance of Feed Particle Size in Layers
Impact of Tarp Colour on Poultry Lighting
SPIDES (Short Period Incubation During Egg Storage)
Fly Management: Surveillance and Control
Optimising Egg Size in Commercial Layers
Vaccination Recommendations
Egg Drop Syndrome (EDS)
Managing Fully Beaked Flocks
Thiamin Deficiency in Pullets
Understanding Nesting Behaviour

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