Using This Guide

Finding a Topic
Blue markers appear on the right-hand side of the guide. These allow readers immediate access to those sections and topics in which they are particularly interested.
The Contents List gives the title of each section and subsection.

Performance Objectives
Supplements to this guide contain performance objectives that can be achieved with good management, environmental and health control.
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The purpose of this guide is to help our customers achieve the optimum level of performance from their Grandparent stock. It is not intended to provide definitive information on every aspect of management, but to draw attention to important issues which, if overlooked or inadequately addressed, may reduce flock performance. The objective is to achieve good overall bird performance and to maintain bird health and welfare.

This Arbor Acres Grandparent Management Guide should be read in conjunction with the Arbor Acres Parent Stock Management Guide because the key principles and procedures of Grandparent stock management are similar to those of Parent stock. For further information on housing, environment, nutrition, and hatchery practices please refer to the appropriate section of the Arbor Acres Parent Stock Management Guide or other available Arbor Acres literature.

The information presented in this guide is a combination of data derived from internal research trials, published scientific knowledge, and the expertise, practical skills and experience of the Aviagen Technical Transfer and Technical Service Teams.

In practice, the implementation of recommendations from a guide such as this cannot wholly protect against variations in performance, because these can be unforeseen and occur for a wide variety of reasons. Every attempt has been made to ensure the accuracy and relevance of the information presented herein, but Aviagen accepts no liability for the consequences of using this information to manage Grandparent stock.

**Technical Services**

For further information, please contact your local Aviagen Technical Service Manager or Technical Department.

[www.aviagen.com](http://www.aviagen.com)
Section 1  Population Sizes and Structure

A typical day-old Grandparent package is given in Table 1. The information in the table is intended for guidance only, as actual package sizes may vary depending on individual customer requirements.

Table 1: An example of a typical day-old Grandparent package

<table>
<thead>
<tr>
<th>Line</th>
<th>Male Line</th>
<th>Female Line</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>A</td>
<td>B</td>
</tr>
<tr>
<td>Sex</td>
<td>Male</td>
<td>Female</td>
</tr>
<tr>
<td>No. of day-olds*</td>
<td>270</td>
<td>300</td>
</tr>
<tr>
<td>No. of birds – after first selection at between 28 and 35 days (4 and 5 weeks) of age</td>
<td>42</td>
<td>291</td>
</tr>
<tr>
<td>Final bird numbers – after second selection at between 126 and 147 days (18 and 21 weeks) of age</td>
<td>28</td>
<td>276</td>
</tr>
<tr>
<td>Percentage of day-old birds retained after ALL selections</td>
<td>10</td>
<td>92</td>
</tr>
</tbody>
</table>

* Changes to this day-old package size may be required due to environmental constraints such as feeder space, floor area or stocking density. Any adjustments to package size should be discussed and agreed with your Aviagen representative.

- The final numbers at 147 days (21 weeks) for both Line B and Line D females are unlikely to exceed 92% of the day-old numbers (typically, mortality in the rearing period will be about 8%).
- At 147 days (21 weeks), the final number of Line B females should not be less than 30% of Line D females. This will ensure that there will be an adequate male to female ratio at day-old in the Parent generation.
Section 2

Key Management Timetable

Objective
The timetable indicates the critical ages during the life of a Grandparent flock and highlights the key management requirements at each age.

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Key Management Timetable

Principle
To use critical age management to achieve the maximum number of good quality day-old Parent stock chicks.

Key management timetable
In order to achieve the maximum number of good quality, healthy day-old chicks, it is essential to understand the requirements of a Grandparent flock at each stage of its life. Critical age objectives are summarized below. Please refer to the appropriate section of the Arbor Acres Parent Stock Management Guide for more details.

<table>
<thead>
<tr>
<th>Age (days)</th>
<th>Whole house Temp °C (°F)</th>
<th>Brooder edge Temp °C (°F)</th>
<th>2m (6.5ft) from brooder edge Temp °C (°F)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Day-Old</td>
<td>30 (86)</td>
<td>32 (89)</td>
<td>29 (84)</td>
</tr>
<tr>
<td>3</td>
<td>28 (82)</td>
<td>30 (86)</td>
<td>27 (81)</td>
</tr>
<tr>
<td>6</td>
<td>27 (81)</td>
<td>28 (82)</td>
<td>25 (77)</td>
</tr>
<tr>
<td>9</td>
<td>26 (79)</td>
<td>27 (81)</td>
<td>25 (77)</td>
</tr>
<tr>
<td>12</td>
<td>25 (77)</td>
<td>26 (79)</td>
<td>25 (77)</td>
</tr>
<tr>
<td>15</td>
<td>24 (75)</td>
<td>25 (77)</td>
<td>24 (75)</td>
</tr>
<tr>
<td>18</td>
<td>23 (73)</td>
<td>24 (75)</td>
<td>24 (75)</td>
</tr>
<tr>
<td>21</td>
<td>22 (72)</td>
<td>23 (73)</td>
<td>23 (73)</td>
</tr>
<tr>
<td>24</td>
<td>21 (70)</td>
<td>22 (72)</td>
<td>22 (72)</td>
</tr>
<tr>
<td>27</td>
<td>20 (68)</td>
<td>20 (68)</td>
<td>20 (68)</td>
</tr>
</tbody>
</table>

Achieve optimum environmental temperature.
In both spot and whole-house brooding systems, it is critical to achieve the optimum temperature to stimulate both appetite and activity as quickly as possible. Brooding temperatures, at an optimum RH of 60 - 70%, are given in the table above.

The temperature experienced by the bird is dependant upon dry bulb temperature and relative humidity. If RH is outside the ideal range of 60 - 70%, the temperature of the house at bird level should be adjusted. If the RH is below 60% or above 70%, the dry bulb temperature may need to be increased or decreased appropriately.

Establish a minimum ventilation rate from day one. This will ensure a supply of fresh air to the chicks, help maintain the temperature and RH, and allow sufficient air exchange to prevent an accumulation of harmful gases. However, it is important to avoid drafts; actual air speed at floor level for young chicks should be less than 0.15 m/s (30 ft/min) or as low as possible.

Chick behavior should be monitored at all stages to ensure that the temperature is satisfactory.

### Before delivery

- Ensure good biosecurity and pre-heat the house. Pathogens can survive in the surrounding environment even if chicks have not been placed. Biosecurity before chick delivery is therefore equally, if not more, important than biosecurity after chick arrival.
- All housing and equipment should be thoroughly cleaned and disinfected, and the efficacy of the operations verified prior to chick placement.
- Temperature and relative humidity (RH) should be stabilized for at least 24 hours prior to chick arrival. Pre-heating the house is essential to ensure that the correct litter and house temperatures are achieved at placement. Litter temperature should be in the range of 28 - 30°C (82 - 86°F) and air temperature at chick level should be 30°C (86°F), ideally with an RH of 60 - 70%.

### On arrival

- Achieve optimum environmental temperature.
- In both spot and whole-house brooding systems, it is critical to achieve the optimum temperature to stimulate both appetite and activity as quickly as possible. Brooding temperatures, at an optimum RH of 60 - 70%, are given in the table above.

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Arbor Acres  
Grandparent Management Guide
Section 2 Key Management Timetable

<table>
<thead>
<tr>
<th>0–3 days</th>
<th>Develop appetite from good brooding practice. Ensure adequate drinker and feeder space, provide good quality feed and maintain optimum temperatures. Monitor bird behavior at all times. Initially, textured feed should be provided as a dust-free crumble, coarse mash or mini-pellet on feeder trays (1/80 chicks) and on paper to give a feeding area occupying at least 25% of the brooding area. Use crop-fill assessment as an indication of appetite development. Crop-fill should be monitored during the first 48 hours, but the first 24 hours are the most critical. An initial check 2 hours after placement will indicate if chicks have found feed and water immediately. To check crop-fill, samples of approximately 30-40 chicks should be collected from each population. Each chick's crop should be felt gently. The crop will be full, soft, and rounded in chicks that have found food and water. If the crop is full but the original texture of the crumb is still apparent, the bird has not yet consumed enough water. Achieve target body weights. First body-weight sample required (male and female). A bulk weighing of birds is required at 7 and 14 days (1 and 2 weeks) of age. A 5% sample or 50 birds, whichever is larger, should be weighed from each population. Use light-weight, portable catching frames for containing birds, and accurate, easy-to-read scales with 20 g (1 oz) increments or electronic scales that are accurate to 1 g (0.05 oz). Where possible, provide a constant short daylength from 10 days of age. In closed houses, a constant 8-hour daylength is recommended for the rearing period. In open-sided houses, daylength will vary according to the placement date and natural daylength patterns. If 14-day (2-week) body weights for previous flocks have regularly been below target, provide a longer daylength until 21 days (3 weeks) of age to help stimulate feed intake and improve body-weight gain.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time of check</td>
<td>Target crop-fill (% of chicks with full crops)</td>
</tr>
<tr>
<td>2 hours after placement</td>
<td>75%</td>
</tr>
<tr>
<td>12 hours after placement</td>
<td>&gt; 85%</td>
</tr>
<tr>
<td>24 hours after placement</td>
<td>&gt; 95%</td>
</tr>
<tr>
<td>48 hours after placement</td>
<td>100%</td>
</tr>
<tr>
<td>14-21 days (2-3 weeks)</td>
<td>Start recording individual body weights between 14 and 21 days (2 and 3 weeks) of age. This information is required to calculate body-weight uniformity.</td>
</tr>
<tr>
<td>28 days (4 weeks)</td>
<td>Males and females must be on or slightly [+20-40 g (0.7-1.4 oz)] above target body weights.</td>
</tr>
<tr>
<td>28-35 days (4-5 weeks)</td>
<td>First selection and grading of males and females. After grading, revise body-weight profiles to ensure that birds achieve the respective target body weights by 63 days (9 weeks).</td>
</tr>
<tr>
<td>35-105 days (5-15 weeks)</td>
<td>If necessary, adjust daily feed allocation for the male and female populations to achieve any revised body-weight targets and maintain uniformity. The main focus during this period is to achieve good skeletal uniformity and to correctly control the growth within each graded population.</td>
</tr>
<tr>
<td>70 days (10 weeks)</td>
<td>Re-examine graded population weights in relation to the body-weight targets. Combine populations that are of similar weight and need the same daily feed allocation. At this age, if populations are not on or following the target profile, a new target body-weight line should be re-drawn parallel to the published targets.</td>
</tr>
<tr>
<td>105 days (15 weeks)</td>
<td>Re-examine body weights in relation to targets. Revise profiles, as necessary, in the same way as was completed at 70 days (10 weeks) of age. Sexing errors should become more obvious from this age onwards. Remove any sexing errors as they are identified.</td>
</tr>
<tr>
<td>105-61 days (15-23 weeks)</td>
<td>Achieve correct weekly body-weight gains by ensuring the appropriate feed amounts are given, particularly from 17 weeks onward.</td>
</tr>
<tr>
<td>126-47 days (18-21 weeks)</td>
<td>Final male and female selection. Any remaining sexing errors should be removed at this final selection.</td>
</tr>
<tr>
<td>Age Range</td>
<td>Description</td>
</tr>
<tr>
<td>-----------</td>
<td>-------------</td>
</tr>
<tr>
<td>140 days (20 weeks)</td>
<td>Calculate and record the uniformity (CV%) of the flock – this should be used to determine the lighting program the flock will receive from 147 days (21 weeks). For example, if a flock is uneven (CV greater than 10%), light stimulation should be delayed by 7 to 14 days (1 to 2 weeks).</td>
</tr>
<tr>
<td>147–154 days (21–22 weeks)</td>
<td>Give first daylength increase, but not before 147 days (21 weeks) of age.</td>
</tr>
<tr>
<td>147–168 days (21–24 weeks)</td>
<td>Mating-up: the exact time of this operation will depend on the relative maturity of males and females. Immature males should never be mated to mature females. If males are more sexually advanced than females, they should be introduced gradually; e.g., mate-up at a ratio of 1:20, then gradually add more males over the next 14 to 21 days (2 to 3 weeks) to reach the desired ratio (see Table 8).</td>
</tr>
<tr>
<td>147–175 days (21–25 weeks)</td>
<td>Introduce the breeder ration. The breeder ration should be introduced at first egg, or by 5% hen-day production at the latest.</td>
</tr>
<tr>
<td>161–196 days (23–28 weeks)</td>
<td>From first egg, increase feed amounts according to the rate of egg production, egg weight, and body weight.</td>
</tr>
<tr>
<td>210 days (30 weeks) until depletion</td>
<td>Manage males by observing bird condition. Remove non-working males to maintain appropriate mating ratios.</td>
</tr>
<tr>
<td>245 days (35 weeks) until depletion</td>
<td>Feed reduction should be started approximately 35 days (5 weeks) after peak production has been achieved, which is generally between 245 and 252 days (35 and 36 weeks) of age. Feed intake should be reviewed weekly and any reductions in feed intake should be based on egg production, egg weight, egg mass, and body weight. <strong>Be vigilant with the male line females.</strong> Feed reductions should be at a slower rate for male line females than for female line females.</td>
</tr>
</tbody>
</table>
Section 3

Feathering Status

Objective
To illustrate the feathering status of the individual lines at the different generations.

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Feathering Status

Principle
The feathering status of the Grandparent lines determines the feathering status of the Parent generation and ultimately the broiler offspring. It is this principle that allows broilers to be feather-sexed at hatch.

Feathering status of Grandparent stock
Birds are genetically either fast or slow-feathering. The type of feathering is identified by observing the relationship between the coverts (upper layer) and the primaries (lower layer) found on the outer half of the wing.

Grandparent Lines A, B, and D are fast-feathered, with the primaries longer than the coverts (Figure 1). The intermediate male line (Line C) is slow-feathered, with the primaries the same length as or shorter than the coverts (Figure 2).

Figure 1: An example of fast-feathering

Fast-feathering chicks will have primaries that are longer than the coverts.

Figure 2: An example of slow-feathering

Slow-feathering chicks will have primaries and covert feathers of a similar size. Occasionally, in slow-feathered chicks, the coverts may be longer than the primaries.

Mating of Grandparent Lines A and B produces the fast-feathered male Parent. Mating of Grandparent lines C and D produces the slow-feathered female Parent (see Figure 3).
**Feather-sexable broilers**

Crossing fast-feathered male Parent stock with slow-feathered female Parent stock produces a male broiler chick which is slow-feathered and a female broiler chick which is fast-feathered (see Figures 1 and 2). It is this difference in the feathering status of males and females that allows the broilers to be feather-sexed at hatch (Figure 3).

**Figure 3: Mating structure**
Section 4
Body Weight Management and Selection – Males

Objective
To select males which have achieved the body-weight target and are free from physical deformities.

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Body Weight Management and Selection – Males

**Principles**
Grow males to the target body-weight profile, using accurate and appropriate grading to aid good uniformity. A physical selection at key ages will ensure good-quality males are available for mating-up.

**First selection and grading of males**
The first selection and grading of males (Lines A and C) both occur between 28 and 35 days (4 and 5 weeks) of age.

**Body weight and grading**
Males should be weighed in bulk for the first 14 days (2 weeks) and individually thereafter to enable calculation of the uniformity (CV%) and to ensure body-weight targets are being achieved (Figure 4). To do this, it is recommended that a minimum of 5% or 50 birds, whichever is greater, is sampled per population.

Between 28 and 35 days (4 and 5 weeks), the males should be graded. This is done by selecting males from the heaviest section of the population (Figure 5). Selection of the heaviest males will improve the uniformity of the selected males allowing body weight and uniformity to be effectively managed. The resulting male population should have a uniformity of 6-8% CV.

**Figure 4**: Example of sample weighing of individual birds for calculation of CV% and determination of mean body weight from 14 days (2 weeks) of age

After the first grading, the objective is to maintain the CV of the population at or below 8%. If, after grading, significant variation occurs and the CV increases above 8%, the reason for this should be investigated (e.g. inadequate feeding space, disease challenge or vaccination reaction) and a re-grading of the male population should be carried out. Re-grade into two populations if CV is between 8 and 12% and into three populations if the CV is greater than 12% (see Figures 9 and 10 for more details).

If necessary, body-weight profiles should be revised after grading (please refer to the Arbor Acres Parent Stock Management Guide for more details).

**First selection**
At first selection, male numbers should be reduced to the following percentages of day-old Line B and D females:

<table>
<thead>
<tr>
<th>Line</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>14%</td>
</tr>
<tr>
<td>C</td>
<td>14%</td>
</tr>
</tbody>
</table>

All unhealthy males and those with leg or feet deformities, spine deformities, poor beaks or poor feather development should be rejected. Figure 6 shows the attributes of a good-quality male that should be retained.
Figure 6: Attributes of a good quality male which should be retained at first selection between 28 and 35 days (4 and 5 weeks) of age

- Eyes should be clear and bright and the beak uniform
- Straight keel bone
- Strong legs and straight toes
The removal of unhealthy or obviously deformed males is a continuous process which should occur whenever males are handled. There are many possible reasons for the rejection of individual birds, but it is unlikely that more than 1% will be rejected during the rearing stage due to ill-health and/or physical deformities.

After selection, males should be kept at a stocking density of 3-4 males per square meter (3.6 - 2.7 ft² per bird).

**Second selection and grading of males**

The second selection and grading of males (Lines A and C) occurs between 126 and 147 days (18 and 21 weeks) and as close as possible to mating-up.

**Body weight**

Body weight should be on target and uniformity (CV) less than 8%, ideally 6%.

Figure 7: Attributes of a good-quality male which should be retained at second selection at between 126 and 147 days (18 and 21 weeks) of age

- Eyes should be clear and bright and the beak uniform
- Straight keel bone
- Straight back
- Straight toes and good leg development

**Second selection**

During the second selection, extremes of the population in terms of body weight, poor-quality birds, such as males with leg or feet deformities, spine deformities, poor comb color, eye abnormalities, poor beaks, poor feather development, and/or sexing errors, should be rejected. Incidences of these rejects should be recorded. Figure 7 shows the attributes of a good-quality male which should be retained at second selection.

At the second selection, male numbers should be reduced to the following percentages of day-old female Line B and D numbers:

<table>
<thead>
<tr>
<th>Line</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Line A</td>
<td>9.3%</td>
</tr>
<tr>
<td>Line C</td>
<td>9.2%</td>
</tr>
</tbody>
</table>
Section 5

Body Weight Management and Selection – Females

Objective
To select females which have achieved the body-weight target and are free from physical deformities.

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- Principles .................................................................22
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- Second selection of females ........................................24
Body Weight Management and Selection – Females

Principles
Grow females to the target body-weight profile, and use accurate and appropriate grading to aid good uniformity. A physical selection at key ages will ensure good-quality females are available for mating-up.

First selection and grading of females
The first selection and grading of females (Lines B & D) occur between 28 and 35 days (4 and 5 weeks) of age.

Body weight and grading
Females should be weighed in bulk for the first 14 days (2 weeks) and individually weighed thereafter. This is to enable the calculation of uniformity (CV%) and to ensure that the recommended body-weight target is being achieved. It is recommended that 5% of females per population or a minimum of 50 females per pen, whichever is greater, are weighed.

Between 28 and 35 days (4 and 5 weeks), the females should be graded (Figure 8).

Figure 8: Grading at between 28 and 35 days (4 and 5 weeks) of age

If the flock CV is less than 12%, a two-way grading should be completed (Figure 9). If the CV is 12% or greater, a three-way grading will be required (Figure 10). After grading, the individual populations should have a CV of no greater than 8%. Please refer to the Arbor Acres Parent Stock Management Guide for more details.

Figure 9: Two-way grading of a flock with a uniformity CV <12%

Figure 10: Three-way grading of a flock with a uniformity CV >12%
First selection

At first selection of the females, obvious culls, rejects, and poor-quality birds should be removed. Figure 11 shows the attributes of a good-quality female which should be retained.

Figure 11: Attributes of a good-quality female which should be retained at first selection at between 28 and 35 days (4 and 5 weeks) of age

- Eyes should be clear and bright and the beak uniform
- Strong legs and straight toes
Second selection of females

The second selection of females (Lines B and D) occurs between 126 and 147 days (18 and 21 weeks) of age or as close to mating-up as possible.

Body weight

If rearing has been successful, body weight should be on target and uniformity (CV) ideally 8%.

Second selection

At second selection, all remaining culls, rejects, sexing errors and poor-quality birds should be removed. Figure 12 shows attributes of a good quality female which should be retained. The second selection should be carried out as near as possible to mating-up time, but it is good practice to remove these birds whenever they are identified, irrespective of age.

Figure 12: Attributes of a good-quality female which should be retained at second selection at between 126 and 147 days (18 and 21 weeks) of age

- Eyes should be clear and bright and the beak uniform
- Strong legs and straight toes
Section 6

Identifying Sexing Errors – Male and Female Lines

Objective
To secure the genetic integrity of the Arbor Acres products.

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Identifying Sexing Errors – Male and Female Lines

Principle
To identify and remove sexing errors before production begins.

Sexing errors
Identifying sexing errors (males present in female pens and females present in male pens) can be difficult at early ages, but it is good practice to remove these birds whenever they are identified during the course of the flock’s life. The criteria for doing this are given in Figure 13 (next page).
Section 6  Identifying Sexing Errors – Male and Female Lines

**Figure 13:** Criteria for identifying males and females for the removal of sexing errors

<table>
<thead>
<tr>
<th>Male</th>
<th>Female</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Comb and Wattles:</strong> (15 weeks)</td>
<td><strong>More developed and redder in males.</strong></td>
</tr>
<tr>
<td><strong>Hock Joints:</strong> (20 weeks)</td>
<td><strong>Thicker and broader in males. Narrower and smoother in females.</strong></td>
</tr>
<tr>
<td><strong>Feathering:</strong> (20 weeks)</td>
<td><strong>Long-fringed, spear-shaped feathers in males. Denser, paddle-shaped feathers in females.</strong></td>
</tr>
<tr>
<td><strong>Body Shape:</strong> (20 weeks)</td>
<td><strong>Males longer and narrower. Females more compact and broader around pelvis.</strong></td>
</tr>
</tbody>
</table>
Section 7

Mating-up

Objective
To maintain optimum flock reproductive performance.

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Mating-up

Principle
Use sexually-mature males and females that are in optimum reproductive condition.

Mating-up
Mating-up should be carried out from 147 days (21 weeks) of age. The operation should be postponed by 7 to 14 days (1 to 2 weeks) if sexual maturity is delayed or the birds are to be moved from dark-out rearing to open-sided adult housing. Care should be taken to ensure that males and females are sexually mature. A sexually mature male will have comb and wattles which are well developed and red in color (Figure 14).

Figure 14: Examples of well-developed males at mating-up, showing a well developed wattle and comb which are red in color

If variation exists in sexual maturity within the male population, the more mature males should be the first to be introduced to the females. Less mature males (Figure 15) should be kept separate to give them extra time for development before they are introduced into the female population.

Figure 15: Example of an immature male, showing a poorly developed wattle and comb which are pale in color

Mating-up at a later stage can allow more effective control of both male and female body weight by reducing/limiting the number of males that are able to access the female feeders; this will allow the daily feed requirements to be calculated more accurately.

Where the practice is to rear and move, it is recommended that the birds are transferred to the adult facilities at 147 days (21 weeks) of age. However, birds may be moved at a younger age, e.g., 133 days (19 weeks), if the adult housing is light-proof.

The mating structure for Grandparent stock is given in Figure 3. Male Parent stock chicks are retained from the mating of Grandparent Line A males to Grandparent Line B females. Female Parent stock chicks are retained from the mating of Grandparent Line C males to Grandparent Line D females.
Section 8

Health and Biosecurity

**Objective**
To minimize the risk of breeding stock becoming contaminated with poultry or human pathogens and to optimize bird performance and welfare.

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- Principle .................................................32
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Health and Biosecurity

**Principle**
Achieve hygienic conditions within the poultry house environment and minimize the adverse effects of disease through adequate biosecurity and vaccination.

**Figure 16:** Example of an isolated, biosecure farm

Health and biosecurity
The *Arbor Acres Grandparent Stock Management Guide* contains advice on the precautions required to minimize the risk of contamination of breeding stock with poultry or human pathogens. These precautions are the minimum standards required for Grandparent stock, because vertically-transmitted infections will be multiplied through each generation and could negatively impact profitability.

The aims of biosecurity are to prevent the introduction and spread of disease from farm to farm and to promote optimum Grandparent performance.

The essential components of a biosecurity program are:

**Structural biosecurity (farm layout and location)**
- Units should be single-age, all-in-all out (as opposed to multi-age). Farms should be isolated from other poultry or livestock operations (e.g., layers, broilers, turkeys, swine, etc.).
- Houses should be designed so that they can be easily cleaned and disinfected, are rodent and wild-bird proof, have no surrounding vegetation, and have a perimeter fence.

**Operational biosecurity (routine procedures)**
- Shower-in/shower-out
- A change of clothing and boots
- Procedures for cleaning and disinfection
- Rodent-control program
- Water-management programs (sanitation and quality)
- Written and posted biosecurity procedures for employees and people visiting farms

Structural and operational biosecurity should be monitored on a regular basis and corrective action taken if either falls below the required standards.

The areas that represent the most significant risk to biosecurity (that is the areas that have the highest risk of disease) are:
- Placement of stock on the premises
- Day-old chicks
- People
- Vehicles and equipment
- Other poultry flocks
- Backyard and wild birds
- Vermin
- Feed (feedstuffs, processing and management)
- Water
- Litter (new, management of and disposal of)
- Management and disposal of dead birds

Each Grandparent operation should identify its own, most significant risk areas and monitor them regularly. Corrective action should be taken if biosecurity falls below the required standards.

**Minimum health standards for Grandparent operations**
The health standards given below are the minimal recommended globally for Grandparent distributors/customers. They represent the absolute minimum standards, or ‘must-haves’, necessary for a Grandparent operation. It is recognized that conditions vary widely around the world and that some Grandparent operations may already meet or even exceed many of these standards. Following these health criteria will minimize the risk to the birds.
1. Salmonellas

- Grandparent operations should be completely free from the high-risk Salmonellas, S. pullorum, S. gallinarum, S. enteriditis, S. typhimurium, and/or other Salmonellas, to comply with local and/or national health plans, regulatory requirements, and customer expectations. The ultimate aim for a Grandparent operation is freedom from all Salmonellas.

- A Grandparent operation must be committed to never knowingly shipping Salmonella-culture-positive stock to any customer requesting negative stock.

2. Mycoplasmas (M. gallisepticum and M. synoviae)

- Grandparent operations should be completely free from Mycoplasmas.

3. Avian Influenza

- Grandparent operations should be completely free from Avian Influenza.

4. Newcastle Disease (Exotic)

- Grandparent operations should be completely free from Newcastle Disease.

- A robust vaccination program must be in place to protect against local field challenge.

5. Avian Leucosis Virus (ALV) and other tumoural diseases

- Verification of ALV negative status should not be a routine requirement, due to the complexities of such testing. However, some customers might request a status report; in which case, please contact an Aviagen veterinarian.

- All stock used in the operation must come from Aviagen-supplied sources.

- Vaccines, especially live vaccines, injected into day-old chicks or young birds must originate from reputable vaccine manufacturers.

- Routine post-mortem protocols must be performed to allow a proper laboratory follow-up (including histopathology and PCR).

- Customer reports of tumoural disease should be investigated properly.

6. Egg Drop Syndrome (EDS) Virus

- Grandparent operations should be completely free from EDS, although vaccination may be necessary in some countries.

7. Marek’s Disease Virus (MDV)

- All stock supplied within a distributors/customers own operation and to its customers must be protected against reasonable MDV challenge.

- Ensure vaccines are properly administered and handled, and that the appropriate vaccine serotype is used.

8. Flocks must have protective levels of maternal antibody (MAB) to the following diseases before the first eggs are saved:

   - Chicken Anemia Virus (CAV)
   - Avian Encephalomyelitis (AE)

9. Flocks should have a program to establish protective levels of MAB for the following diseases (within some countries, legislation may prohibit vaccination of one or more of them):

   - NDV (PMV-1)
   - Infectious Bronchitis (IB)
   - Infectious Bursal Disease (IBD)
   - Reovirus

10. Many species of Aspergillus are recognized as being pathogenic to day-old chicks. It must be the aim to deliver stock to customers which is free from clinical Aspergillus infection.

11. Health Certification – Flock and stock movement must meet all domestic and export requirements.

12. Laboratory Facilities

   - Laboratory facilities supporting Grandparent operations must meet designated standards.

   - Laboratory tests must be performed following nationally or universally recognized technical standards. It is recommended that the laboratory staff be properly trained.

   - Salmonella and Mycoplasma monitoring
      
     i. Written protocols for the routine monitoring of flocks for Salmonellas and Mycoplasmas must be maintained and there must be documentation to indicate that the protocol has been followed. Test results must be recorded and kept for at least one year after depletion.

     ii. Testing frequencies should be established by a veterinary team. An Aviagen veterinarian can help determine the testing program.

   - An agreed communication and response plan must be in place for confirmed positives of Salmonella and M. Gallisepticum/M. Synoviae or for any other major disease outbreak. Each company should develop their own response plan.
13. Hatchery

a. Hatchery flows, air handling, etc. must be correctly designed to prevent cross-contamination between dirty and clean areas and to facilitate regular cleaning and disinfection.

b. Materials used in the construction of the hatchery must enable frequent and adequate cleaning and disinfection.

c. There should be routine monitoring of cleaning and disinfection procedures.

d. Accurate records must be kept of hatches, breakouts, culls, etc. from identified flock sources.

e. It is highly recommended that written Standard Operating Procedures (SOPs) and records for all critical processes affecting health (e.g., from Marek’s vaccination to water sanitization) are completed.

f. SOPs should also be in place for vaccine handling and administration.

g. A robust system to identify progeny according to flock source must be in place (traceability).

Antibiotic administration

Antibiotic administration must be for therapeutic use only and must only be used as a tool to treat infections, prevent pain and suffering, or to preserve the welfare of flocks. Antibiotics should only be used under a veterinarian’s direct supervision. Records should be kept of all prescriptions.

Documentation and records

Records should be maintained for auditing and traceability purposes. These should be clear, legible, and detailed enough to allow investigation into possible causes of poor quality, poor performance, morbidity or mortality. Records may also be used as a checklist by staff to ensure tasks have been carried out.

Vaccination programs

Vaccination programs must be designed according to local disease challenges and the maternal antibody requirements of Parent stock. A suitable vaccination program should be established by the local veterinarian responsible for the health status of the operation. Aviagen veterinarians are available to provide suggestions or advice.

Salmonella and feed hygiene

Salmonella infections originating from contaminated feed represent a major threat. The risk of infection comes from both contaminated feed and from re-contamination via the environment. The risk of feed contamination can be minimized by thermal processing of the feed and/or addition of feed additives with antimicrobial activity. Monitoring of raw materials will provide information about the size of challenge coming through ingredients.

Raw materials of animal origin and processed vegetable proteins are high-risk and their source and use in feeds for Grandparent stock should be considered carefully.

Thermal processing of feed is frequently used to reduce bacterial contamination. The aim is less than 10 Enterobacteriaceae per gram of feed. Aviagen’s Technical Department has extensive experience in the development and application of heat treatment programs and should be consulted.
Objective
To ensure the use of high quality Grandparent feed(s) which will ensure optimum flock performance.

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Feeding and Nutrition

Principle
To ensure the use of high quality feed(s) for Grandparent stock through the use of appropriate feed formulation and biosecurity.

Feeding and nutrition
For general information about the nutrition and feeding of Grandparent stock refer to the Arbor Acres Parent Stock Management Guide. Arbor Acres Parent stock nutrition specifications are suitable for Grandparent stock nutrition. The main differences between Parent stock and Grandparent stock nutrition relate to:

(1) The economic differences between the two production systems, and
(2) The need for greater feed biosecurity with Grandparent stock.

Economics of feeding
• The value of chicks produced by Grandparent stock (day-old Parent stock) is greater than the value of chicks from Parent stock production (day-old commercial broilers). In addition, the quality and viability of Grandparent chicks is important for producing viable Parent stock.

• Feed cost is therefore a smaller proportion of the output revenues in Grandparent production. Small nutritional responses which may be uneconomic in Parent flocks, are likely to be viable in Grandparent flocks. Variations in feed costs per ton contribute less to the profitability of a Grandparent flock than to a Parent flock.

• The high value of Grandparent progeny affects decisions on ingredient choice, vitamin sources and levels, mineral sources (e.g., the use of organic minerals), and the use of some nutritional supplements. These decisions should be made according to local conditions.

Feed milling and biosecurity
• A detailed feed biosecurity program is essential for Grandparent stock. The feed biosecurity program should be more thorough for feed given to Grandparent stock than for Parent stock. A more robust cost of risk assessments should be adopted.

• All feed must be considered a potential source of Salmonella infection. The most reliable method of decontaminating feed is heat treatment. Studies have shown that treating feed at 86°C (189°F) for 6 minutes will reduce the total viable bacterial count to less than 10 organisms per gram. Care must also be taken to prevent re-contamination of treated feed; the use of chemical control, including products like organic acids, is beneficial in achieving this.

• The feed biosecurity program should be comprehensive and include:
  - ingredient purchasing
  - feed production
  - distribution

Any feed biosecurity program should be monitored and validated on a regular basis to ensure that it does not affect nutritional integrity.

• Feed ingredients for Grandparent stock should meet the highest biosecurity standards. Animal products, except for tested fish meals, should not be used in Grandparent feeds.

• All ingredients should be monitored for nutrient stability under heat treatment conditions. Vitamins and additives are particularly important because they are less heat stable. Any post-manufacture inclusion of nutrients or additives must meet biosecurity restrictions.

• Potential nutritional damage from feed treatments should be carefully monitored. Heating feed or extending holding time beyond recommended limits can affect carbohydrate availability, damage feed proteins, and destroy vitamins. It is important that the heat stability of nutritional additives, e.g., enzymes, is understood.

• An annual evaluation of vitamin stability during manufacture should be undertaken and, where necessary, levels adjusted to ensure concentrations in finished feed are correct. This evaluation should include as many vitamins as practically possible.
Section 10

Care of Hatching Eggs and Incubation

Objective
To ensure that the hatchability potential of the egg is maintained from the time of lay to the time of hatch.

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Care of Hatching Eggs and Incubation

Principle
Keep eggs in clean and hygienic conditions, with the correct environmental temperature and humidity, from the time they are laid until hatch.

Hatching egg identification
It is recommended that all male line eggs be individually marked before being taken from the pen to prevent accidental mixing of hatching eggs (Figure 17).

Figure 17: Example of hatching eggs that have been stored under optimal conditions

Some rules of egg storage
- Eggs benefit from a period of rest after transportation; do not set eggs on arrival at the hatchery, but allow them to settle in the egg store for at least 24 hours.
- The egg store should be well-insulated, and the door kept closed whenever possible.
- Do not allow air from inlets and air coolers to blow directly on to eggs.
- Ceiling fans help provide a gentle air movement through the eggs and will reduce spatial variation in temperature in large egg stores (Figure 18).

Figure 18: Egg store with good environmental control

- Ensure that the temperature, humidity, and pre-warming period is appropriate for the length of time that the eggs are expected to be in store prior to setting (Table 2):

Table 2: Egg storage conditions

<table>
<thead>
<tr>
<th>Storage period (days)</th>
<th>Temperature of store °C (°F)</th>
<th>Humidity (RH%)</th>
<th>Pre-warming at 23°C/73°F (hours)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 - 3</td>
<td>20 - 23 (68 - 73)</td>
<td>75</td>
<td>n/a</td>
</tr>
<tr>
<td>4 - 7</td>
<td>15 - 18 (59 - 64)</td>
<td>75</td>
<td>8</td>
</tr>
<tr>
<td>&gt; 7</td>
<td>12 - 15 (54 - 59)</td>
<td>80</td>
<td>12</td>
</tr>
<tr>
<td>&gt; 13</td>
<td>12 (54)</td>
<td>80</td>
<td>18</td>
</tr>
</tbody>
</table>

- Eggs which have been stored at 12°C (54°F) are likely to sweat (as indicated by condensation on the egg shell) if not given a short time at an intermediate temperature before pre-warming. This can be achieved by transferring them to a room with a temperature of between 15 and 18°C (59 and 64°F) the day before they are due to be set.
- Eggs which have been stored take longer to hatch (about 1 hour per day of storage) and suffer reduced hatchability.

It may be beneficial in smaller farming programs, where eggs are often saved for longer periods to improve egg utilization, to turn eggs once a day. This can be done by installing incubator turning mechanisms in the egg holding room (high-tech) or by boxing the eggs destined for longer storage and turning the boxes daily (low-tech). Turning should start as soon as possible after the eggs have been put into the store.
Incubation

1. Eggs should lose between 11.5 and 12.5% of their weight between setting and transfer to the hatcher at 18 days.

2. At take-off, chicks should weigh 67 - 69% of the weight of the egg when it was set.

3. Incubation times vary for the lines that make up the different Grandparent packages. The Arbor Acres female line female (Line D) is one of the slower hatching lines, and the male line female (Line B) is one of the faster hatching lines. Female line eggs should be set to give them 6 - 8 hours longer incubation than the male lines.

4. Within a hatchery, check the window of hatch by monitoring the hatcher baskets 30 hours before the chicks are due to be taken off. There should be no more than three chicks per tray at this time. Excessive amounts of meconium on the egg shells at take-off may indicate that chicks are hatching earlier than planned (Figure 19).

5. The safest way to alter hatch time is to delay setting the eggs by the appropriate number of hours.

6. Overheating in the setter or the hatcher will adversely affect both chick quality and liveability. Shell temperature at 18 days should not exceed 38.3°C (101°F) (Figure 20). Chick-vent temperatures at take off should not exceed 41°C (105°F). If they are too hot, the chicks will be panting slightly. If necessary, increase cooling to keep temperatures down.

7. Hatchability will be reduced in eggs stored for more than 7 days from day of lay. Hatchability will drop by 0.5% points per day of storage between 7 and 11 days, and by 1.8% per day for eggs that have been stored for 12 or more days.
Section 11 General Management Information

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General Management Information

Line identification
All Grandparent Lines are individually marked at the hatchery for future identification. The identification markings used should be agreed between Aviagen and the customer before the eggs are set.

Stocking densities

Table 3: Recommended stocking densities for male and female lines

<table>
<thead>
<tr>
<th>Period</th>
<th>Males birds/m² (ft²/bird)</th>
<th>Females birds/m² (ft²/bird)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rearing 0 - 140 days (0 - 20 weeks)</td>
<td>3.0 - 4.0 (3.6 - 2.7)</td>
<td>4.0 - 7.0 (2.7 - 1.5)</td>
</tr>
<tr>
<td>Production 140 days (20 weeks) until depletion*</td>
<td>3.5 - 5.5 (3.1 - 2.0)</td>
<td>3.5 - 5.5 (3.1 - 2.0)</td>
</tr>
</tbody>
</table>

* Male lines are recommended to have 10% more floor area than the female lines in the production period.

Actual stocking density will depend on climate, equipment and local economics. The range of figures quoted represent typical variations in conditions from tropical to temperate climates.

Feeding Space

Table 4: Recommended female feeding space

<table>
<thead>
<tr>
<th>Tracks</th>
<th>Pans</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>Female line cm (in*) per bird</td>
</tr>
<tr>
<td>--------</td>
<td>-------------------------------</td>
</tr>
<tr>
<td>0 - 35 days (0 - 5 weeks)</td>
<td>5 (2)</td>
</tr>
<tr>
<td>36 - 70 days (5 - 10 weeks)</td>
<td>10 (4)</td>
</tr>
<tr>
<td>71 days (10 weeks) until depletion</td>
<td>15 (6)</td>
</tr>
</tbody>
</table>

* Imperial figures have been rounded to the nearest whole number.

When adequate feeder space is given, the distribution of birds around the feeder will be similar to that illustrated in Figure 21.

Figure 21: Uniform bird distribution at feeding time when adequate feeder space is given (pan and chain feeders)

When using separate sex feeding devices (grills/toast racks), care is required to check for any unwanted exclusion of birds from the feeder, especially after 45 weeks. This is particularly important with the male lines.

Drinking space

Table 6: Drinking space requirements – male and female lines

<table>
<thead>
<tr>
<th>Type of drinker</th>
<th>Rearing period</th>
<th>Production period</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bell drinkers</td>
<td>1.5 cm/0.6 in</td>
<td>60 - 75 birds/drinker</td>
</tr>
<tr>
<td>Nipples</td>
<td>8 - 12 birds/nipple</td>
<td>6 - 10 birds/nipple</td>
</tr>
<tr>
<td>Cups</td>
<td>20 - 30 birds/cup</td>
<td>15 - 20 birds/cup</td>
</tr>
</tbody>
</table>

When adequate drinker space is given, the distribution of birds around drinkers will be similar to that illustrated in Figure 22.
Figure 22: Uniform bird distribution around the drinkers when adequate drinker space is given (bell drinkers, nipple lines, and cups)

Nesting space
Manual, individual nest boxes (Figure 23).
- One nest hole for every 3.5 - 4.0 females; male lines are best suited to 3.5 birds per nest with female lines at 4.0 birds per nest.
- Dimensions 30 cm wide x 35 cm deep x 25 cm high (12 in x 14 in x 10 in).

Figure 23: Examples of manual nest boxes

Automatic, communal nest boxes (Figure 24).
- Approximately 40 birds per linear meter (12 birds per linear foot) for female lines and 36 birds per linear meter (11 birds per linear foot) for male lines.

Figure 24: Example of an automatic, communal nest box
Lighting program

If the flock is photostimulated at 147 days (21 weeks) of age, the first egg should be produced 10 - 14 days later and 5% hen-day production achieved by 175 days (end of the 25th week). If the target for 5% production is different from 175 days (25 weeks), the age at which the first light increase is given should be adjusted accordingly (± 5 days for each 2-day difference in maturity).

Table 7: Recommended lighting program to achieve 5% hen-day production at 175 days (25 weeks) of age in closed houses

<table>
<thead>
<tr>
<th>Age</th>
<th>Hours of light (CV% at 133 days)</th>
<th>Light intensity</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Days</td>
<td>Weeks</td>
</tr>
<tr>
<td>1</td>
<td>23</td>
<td>23</td>
</tr>
<tr>
<td>2</td>
<td>23</td>
<td>23</td>
</tr>
<tr>
<td>3</td>
<td>19</td>
<td>19</td>
</tr>
<tr>
<td>4</td>
<td>16</td>
<td>16</td>
</tr>
<tr>
<td>5</td>
<td>14</td>
<td>14</td>
</tr>
<tr>
<td>6</td>
<td>12</td>
<td>12</td>
</tr>
<tr>
<td>7</td>
<td>11</td>
<td>11</td>
</tr>
<tr>
<td>8</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>9</td>
<td>9</td>
<td>9</td>
</tr>
<tr>
<td>*10-146</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td>147 - 154</td>
<td>21</td>
<td>11</td>
</tr>
<tr>
<td>154 - 161</td>
<td>22</td>
<td>12</td>
</tr>
<tr>
<td>161 - 168</td>
<td>23</td>
<td>13**</td>
</tr>
<tr>
<td>168 - 175</td>
<td>24</td>
<td>13</td>
</tr>
<tr>
<td>175 - 182</td>
<td>25</td>
<td>13</td>
</tr>
</tbody>
</table>

* Constant 8-hour daylength and 10 - 20 lux light intensity should be achieved by 21 days (end of week 3), but no later.
** Extending the daylength beyond 13 hours in the laying period has been shown to give no increased biological benefits.

There are three possible combinations of lighting environment:
1. Controlled-environment (closed) rearing and controlled-environment (closed) laying
2. Controlled-environment (closed) rearing and open-house/curtain-sided (brown-out) laying
3. Open-house/curtain-sided (brown-out) rearing and open-house/curtain-sided (brown-out) laying

The program given in Table 7 is for situations where controlled-environment (closed) rearing and laying housing is practiced. Further details of lighting programs for the other situations can be found in the Arbor Acres Parent Stock Management Guide.

Mating ratio guide

The recommended mating ratios for Grandparent stock are given below.

Table 8: Recommended mating ratios during production

<table>
<thead>
<tr>
<th>Age</th>
<th>Mating Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Days</td>
<td>Weeks</td>
</tr>
<tr>
<td>210</td>
<td>30</td>
</tr>
<tr>
<td>245</td>
<td>35</td>
</tr>
<tr>
<td>280</td>
<td>40</td>
</tr>
<tr>
<td>315 - 350</td>
<td>45 - 50</td>
</tr>
<tr>
<td>420</td>
<td>60</td>
</tr>
</tbody>
</table>

Higher ratios may be required in open-sided laying houses. The actual mating ratios used will depend on the physical condition of both males and females.
Feeding into lay

- Feed amounts up to the onset of production will be primarily dependent upon body weight.
- The first feed increase for egg output should be at 3 to 5% hen-day production if flock CV is 10% or less and at 10% production if flock CV is greater than 10%.
- Feed amounts up to and at peak will be primarily dependent on rate of egg production, but egg weight, body weight, bird condition, uniformity, eating-up time, and ambient temperature should also be considered.
- Uniform flocks will tend to come into production more rapidly than the performance specifications and feed amounts should be adjusted accordingly. Further feed increases >70% production may be required as additional feed can improve chick quality.
- If a feed energy level different from 11.8 MJ/kg or 5.3 MJ/lb (2800 kcal/kg or 1270 kcal/lb) ME is used, daily feed allocations must be adjusted proportionally.

Table 9: General guidelines for female line feed reduction

<table>
<thead>
<tr>
<th>Age</th>
<th>Feed Reduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Peak to 35 weeks</td>
<td>hold at peak feed allocation</td>
</tr>
<tr>
<td>36-50 weeks</td>
<td>gradual reductions to 411 kcal ME/bird/day (147 g or 5.2 oz/bird/day) minimum</td>
</tr>
<tr>
<td>&gt;50 weeks</td>
<td>gradual reductions down to 400 kcal ME/bird/day (143 g or 5.0 oz/bird/day) minimum</td>
</tr>
</tbody>
</table>

Table 10: General guidelines for male line feed reduction

<table>
<thead>
<tr>
<th>Age</th>
<th>Feed Reduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Peak to 33 weeks</td>
<td>hold at peak feed allocation</td>
</tr>
<tr>
<td>34-50 weeks</td>
<td>gradual reductions to 436 kcal ME/bird/day (156 g or 5.5 oz/bird/day) minimum</td>
</tr>
<tr>
<td>&gt;50 weeks</td>
<td>gradual reductions down to 408 kcal ME/bird/day (146 g or 5.1 oz/bird/day) minimum</td>
</tr>
</tbody>
</table>

Post-peak feed reduction

- Make feed adjustments weekly in response to observations of production, body weight, egg weight, egg mass, bird condition, feed clean-up time behavior and environmental temperature.
- Feed allocation decisions should always consider environmental and temperature changes. As a rule of thumb, for each 3°C (5°F) change in temperature the energy requirement will increase or decrease by 15 kcal ME/bird/day. For example, if the average temperature increases from 21.1 to 26.7°C (70 to 80°F) the energy requirement would decrease by 30 kcal ME/bird/day. If the temperature decreases from 21.1 to 15.6°C (70 to 60°F) the energy requirement would increase by 30 kcal ME/bird/day.
- Post-peak feed reduction
  - Follow a program of feed reduction that allows the females to gain weight steadily at 15-20 grams (0.5-0.7 oz) per week, and maintain egg production, body weight, and egg weight profiles.
  - Start feed reduction in the period approximately 35 days (5 weeks) after peak production (approximately 21 days [3 weeks] for the male line). The rate of reduction will be dependent upon production, egg weight, bird condition, body weight, feed quantity, feed energy level and temperature.
  - Do not make a total energy reduction of more than 53 kcal ME/bird/day for female lines and 59 kcal ME/bird/day for male lines between peak production and depletion.
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