Optimum broiler development

A practical guide to ensure correct early broiler performance

Cobb®

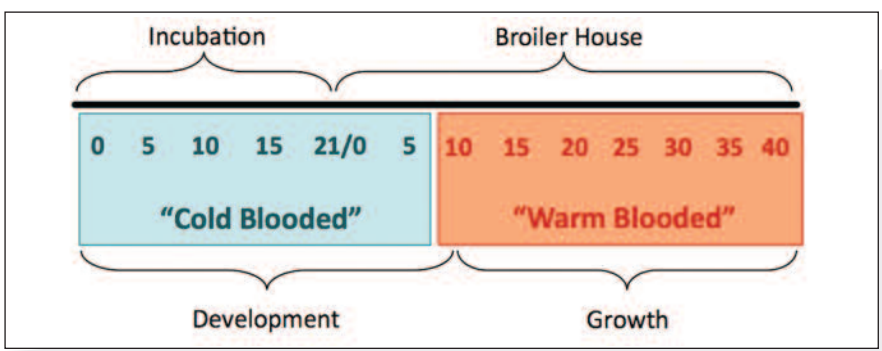
Contents

The Optimum Broiler Development Guide is intended as a reference and supplement to your own flock management skills so that you can apply your knowledge and judgment to obtain consistently good results with the Cobb family of products.

Introduction

It is crucial for broiler performance to ensure a proper development of the chick (incubation + first 10 days of grow-out) especially because the chick does not have the ability to properly control its body temperature ('Cold Blooded') during this period.

Winter temperatures pose an additional challenge to the development of chick and the subsequent adult broiler. This is mainly due to poor temperature control and also to compromized ventilation in the broiler houses. Good stockmen have the responsibility to maintain a good environment for the chick to maximize the birds' genetic potential.



Objectives

1. Review all the management aspects, in a check list form, that will help maintain broiler performance from the hatchery to the broiler house.

2. Define a few practical measurements that will indicate a successful incubation/brooding and a well developed broiler:
   - Chick quality measurements
   - Chick check
   - 7-day mortalities
   - 7-day weights

1.1. Why focus on incubation

- Today's meat yield birds produce higher embryonic temperatures and the risk of embryos overheating is higher.
- Hatchery ventilation and incubation temperatures, particularly during winter time, must be able to cope with this or serious damage can be done to the chicks.
- Less active, weaker chicks will show poorer starts and final performance. This will be specially true if brooding/growing conditions are challenging (winter).

	Embryo temp	% Chick w/o yolk	% Yolk	% Heart
Setter High	104.0°F (40°C)	55.9a	20.1a	0.632a
Setter Low	102.4°F (39.1°C)	58.9b	17.6b	0.757b

Research from M. Wineland, NCSU, 2001

Both chicks live weight 48g

Pics courtesy of Ron Meijerhof.

Day 16-21 temp (embryo)	Bodyweight	FCR (2kg)
99.5°F (37.5°C)	2,214g (4.88 lbs)	1.82
101.5°F (38.6°C)	2,263g (4.98 lbs)	1.75
103.5°F (39.7°C)	2,166g (4.77 lbs)	1.80

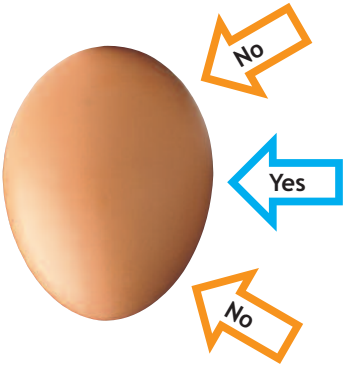
Hulet et al (Pennsylvania State University)

1. Hatchery

1.2. What to measure?

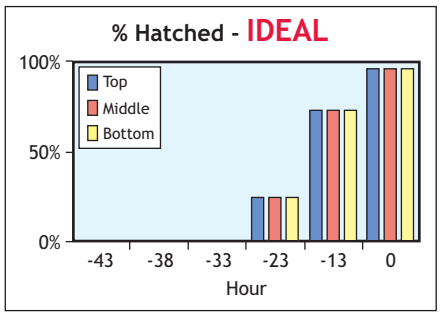
- Embryo temperatures can be estimated accurately by egg shell temperatures, when taken on fertile eggs and on the egg's equator with a thermoscan thermometer between 15 and 16 days of incubation.

Embryo Temp	Qualification	Consequences
98.0 - 99.9°F (36.7-37.7°C)	Too cold	Slow hatch
100.0-100.5°F (37.8-38.1°C)	Optimum	Good hatch and chick quality
100.5-102.5°F (38.1-39.2°C)	Too warm	Good hatch, poorer chick quality
102.5-104.0°F (39.2-40.0°C)	Too hot	Poor hatch and chick quality



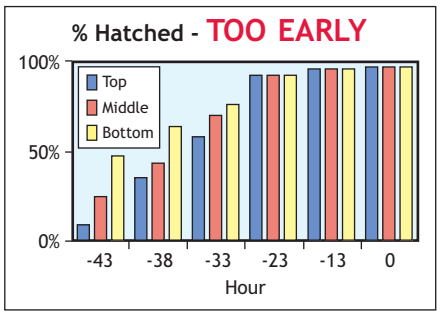
- Two key measurements help identify correct temperatures and ventilation:
  - **Hatch window**
  - **Uniformity of embryo temperatures**

1.21. What to measure? - Hatch window and uniformity of embryo temperatures



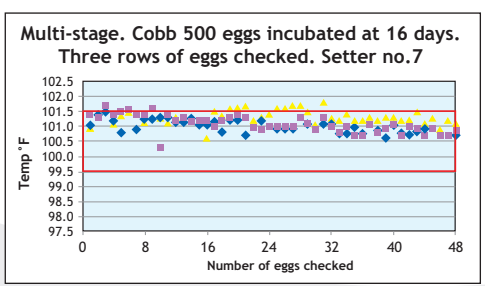
Hatch Window

Targets are for the chicks to hatch:
Max. 25%, 24 hours prior to pull
Max. 75%, 12 hours prior to pull



Uniformity of shell temperatures

- Measured with an thermoscan thermometer
- Aimed at identifying hot/cold spots in the setters
- Infertile eggs must not to be accounted for as they have shell temperatures of 2-3˚F (1.1-1.7˚C) lower than eggs with living embryos



Red outline indicates minimum to maximum acceptable temperature 99.5˚F to 101.5˚F (37.5˚C to 38.6˚C)
Ron Meijerhof

In this example, uniformity of temperatures was very good but set points too high for the embryos.

1. Hatchery

1.22. What to measure? - Cleanliness on egg shells

Excess meconium residues on egg shells is a good subjective indication that chicks have hatched too early and stayed too long on the hatcher baskets.

Too dirty

Adequate

1. Hatchery

1.3. How to establish good chick quality?

- Traditional chick grading standards (right), while also important, do not always pick up damage due to overheating.
- Overheated chicks hatch earlier than normal and usually show (see research from Wineland and Hulet):
  - Weakness, tiredness
  - Will be smaller (shorter)
  - Dehydration
  - Smaller hearts, digestive system and less developed immune systems
  - Bigger yolk sacs (less absorption)
  - More prone to bacterial infections (E.Coli)
  - More leg problems

1. Hatchery

1.31. How to establish good chick quality? - Colour and strength

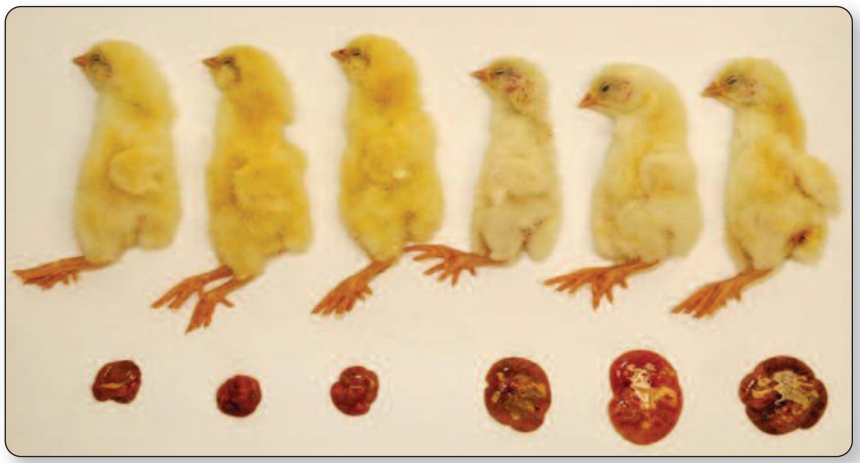
Strong, alert chicks

Weak chicks

- Chicks should be bright yellow. Overheated chicks have poorly absorbed yolk sacs and hence pigments and are whiter than normal. *Caution: Formaldehyde masks white chicks*

- Chicks should stand up and be active. If placed on their backs they should turn themselves within seconds.

1.32. How to establish good chick quality? - Yolk free body mass (YFBM)



Overheated chicks are smaller and have bigger, non-absorbed yolk sacs.

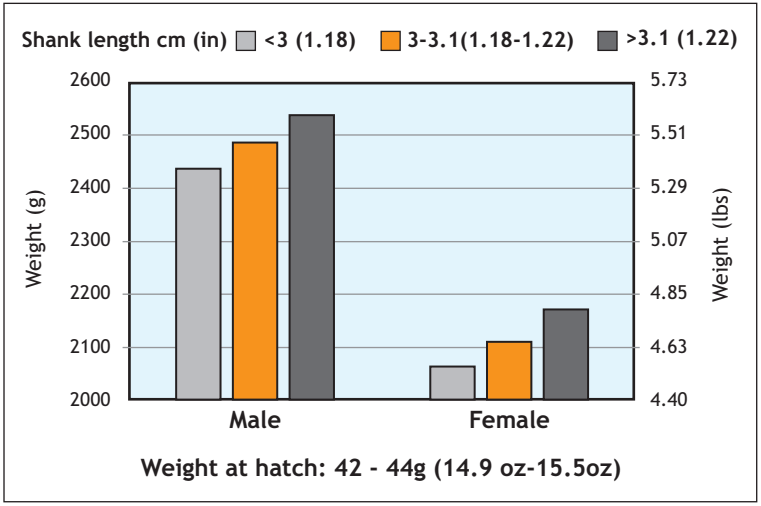
The more serious cases of poorly absorbed yolk sacs translate in unhealed navels.

Target	
% Yolk/Chick weight	<10%
% YFBM/Chick weight	>90%

1. Hatchery

1.33. How to establish good chick quality? - Chick/shank length

- Overheated chicks are smaller since they required protein during incubation to be used as an energy source rather than to grow muscle.
- Chick and shank lengths are difficult measurements to obtain consistently and require practice.



'Het Spelderholt' research center.

Breeder Age	Target	Too Small
26-35 weeks	19-21cm (7.5-8.25 in)	<17.5cm(6.9in)
36-45 weeks	19.5-21.5cm (7.68-8.46 in)	<18.0cm (7.1in)
>45 weeks	20-22cm (7.85-8.65 in)	<18.5cm (7.3in)

1. Hatchery

1.34. How to establish good chick quality? - Feathering

- Good feather development is synonymous with good chick development during incubation (chicks must look fluffly!).
- However, excess development of the wing feathers does indicate early hatching (overheating) and excessive time in the hatcher baskets.

Well advanced (open), hatched too early

Correct development

1. Hatchery

1.35. How to establish good chick quality? - Colibacillosis control

- This is the most common infectious disease of poultry and is world wide in incidence.
- Infection is via the oral route, yolk/navel, shell membrane or water, and the incubation period is 3-5 days.

Egg shell contamination and 14 day mortality

Egg condition	Total bacteria	Coliforms	14 day mortality
Clean	600	123	0.9
Soiled	20,000	904	2.3
Dirty	80,000	1,307	4.1

(J. M. Mauldin)

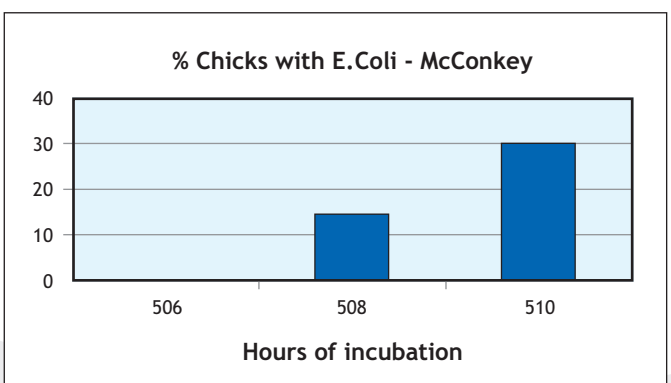
- Poor navel healing, mucosal damage due to viral infections and immunosuppressive challenges are pre-disposing factors to infection.

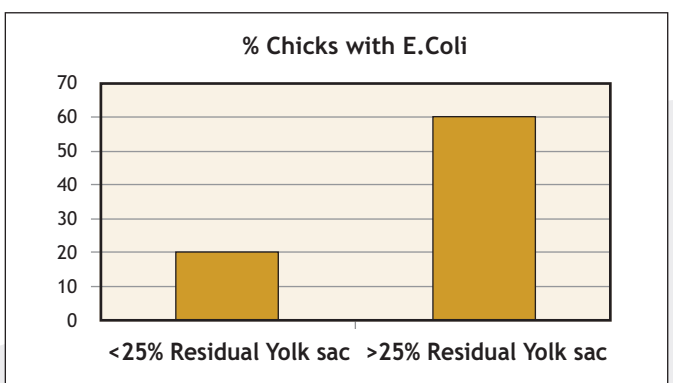
1.35. How to establish good chick quality? - Colibacillosis control

Consequences of overheating embryos
E. Coli susceptibility *(Trial Cobb Spain, 2011)*

It is not clear if overheated embryos are more sensitive because they spend longer in the hatchers (hatch early) but, the % of E.Coli isolations seem to increase with:

- Hours of incubation
- Bigger yolk sacs





1. Hatchery

1.35. How to establish good chick quality? - Colibacillosis control

- Treatment is by antibiotic treatment and type of product used depends on resistance of the bacteria isolated.
- Contaminated hatch debris and chick fluff in the hatchery are major sources of bacterial infection.
- Prevention includes good hygiene of hatching eggs and good hygiene in the hatchery.
- Good hygiene on the farm at depletion is also important because the bacteria are readily killed by disinfection.
- Water hygiene is also potentially important and chlorine at 3 ppm is a good option (water ph dependant (ph <7)).
- Fumigation in the hatchers with formalin has shown good results in reducing bacterial load.

Duration	Solutions	Volume
From transfer to six hours before take off	Formalin solution diluted 1:1 with water (final solution of Formalin 17-18%)	60 ml of solution per m^3 of Hatcher space (7.7 ounces per $35ft^3$), in pans with surface area of 50 cm^2/m^3 ($23in^2$ per $100ft^3$).

1. Hatchery

1.4. Incubation and leg issues

- Leg splayed from the coxofemoral.
- High incubation temperatures lower glycogen reserves in muscles and their mircofibers are thinner.
- High incubation temperatures lead to depletion of glycogen in the muscles resulting in increased lactic acid and increased muscle fatigue.
- Collagen fibers are thinner in high incubation temperatures (39°C/102.2°F).
- Bones initiate ossification at 16 days of incubation and under go fastest elongation rate 3-4 days before hatch. High temperatures negatively affect this growth.

(1.4 reference: Rondon and Wineland North Carolina)

1. Hatchery

1.5. Chick holding

- Variation of min. and max. temperatures kept to within +/- 1°C (1.8°F) in holding room.
- Ceiling paddle fans/puka fans should direct air towards the ceiling and not down on chicks to cause chill effects.
- Blue lights or lower light intensity will reduce stress.
- Stocking density in chick boxes minimum 21cm^2 (3.25in^2) per chick.

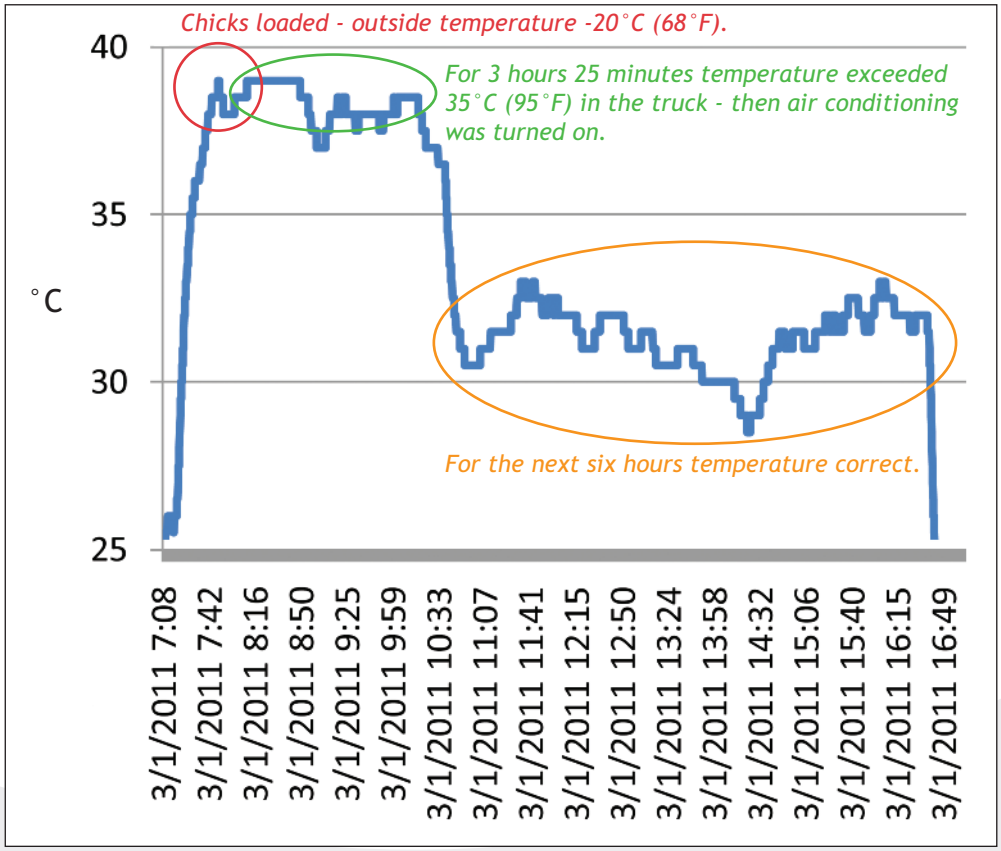
2. Chick transport

- Temperatures in plastic boxes should be maintained at 32°C (89.6°F) for the chicks.
- The vehicle cargo hold should maintain a stable temperature of 24°C (+/- 1°C) (75.2°F [+/-1.8°F]) from hatchery to farm.

- On arrival, face the vehicle into the prevailing wind to prevent wind chill on the chicks during unloading.
- Only unload trolleys of chicks to meet the pace of the staff. Do not have trolleys of chicks waiting on the concrete pad outside the house.

2. Chick transport

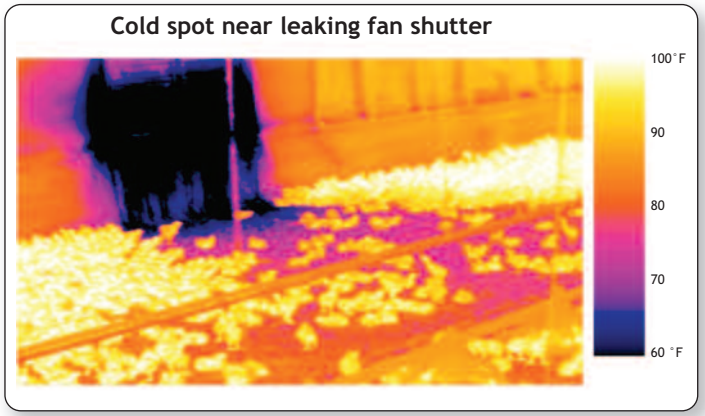
2. Chick transport



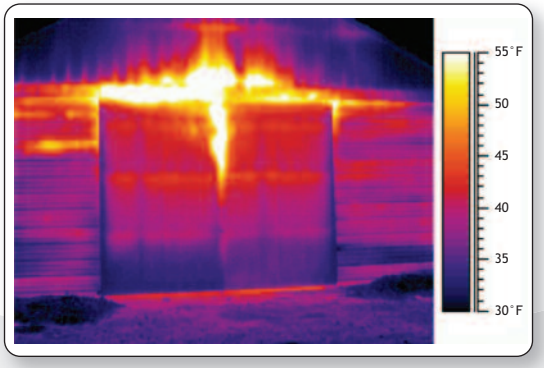
The graph shows excessive temperature in chick boxes during transport where box temperature exceeded 35˚C (95˚F) for over three hours - seven day mortality of this flock was 1.55% mainly because of culling of small chicks.

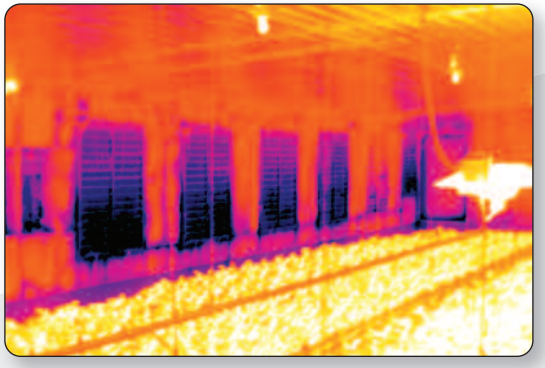
3.1. Ventilation

- You cannot properly ventilate or control temperature if the house is not sealed (has air leaks). Test the effectiveness of how well the house is sealed by closing all the inlets, then open a door slightly ajar or crack open an inlet with one fan running → should record a pressure in excess of 37.5 pascals (.151 inches of water) at the inlet. If < 25 pascals (.10 inches of water), it indicates that the house is poorly sealed.
- Use plastic sheeting on outside and inside of doors to seal.



Pictures courtesy of Dr. Mike Czarick - University of Georgia.





3. Brooding

3.1. Ventilation

- There must be no drafts (either warm/cold) at floor level for the first fourteen days of age at least - during this period a draft is any air movement that exceeds 0.3m/sec (60 feet/minute) at floor level.

- The table below indicates the parameters of these key areas to maintain good atmospheric conditions.

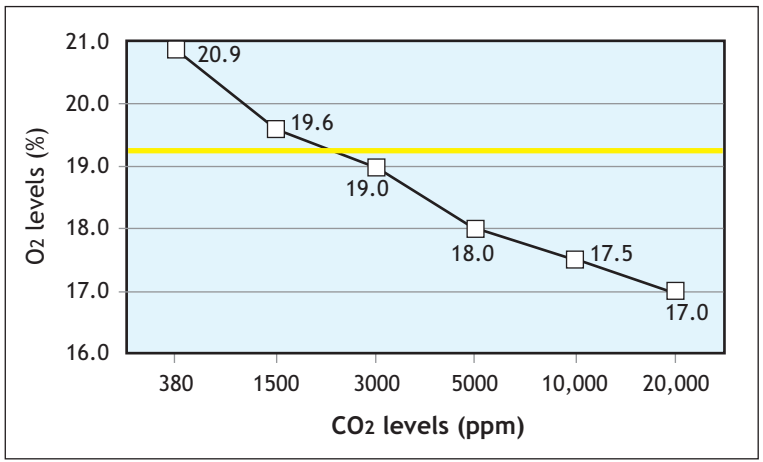
Air quality guidelines	
Oxygen %	> 19.6%
Carbon Dioxide (CO_2)	< 0.3% / 3000ppm
Carbon Monoxide	< 10ppm
Ammonia	< 10ppm
Inspirable Dust	< 3.4mg/m^3 (.0001oz/35.3 ft^3)
Relative Humidity	45 - 65%

Minimum ventilation must never be sacrificed.

- Minimum ventilation must be increased if CO_2 levels exceed 3,000ppm or oxygen levels less than 19.6%.

3. Brooding

3.1. Ventilation



CO_2 level too high at placement in a broiler house

3. Brooding

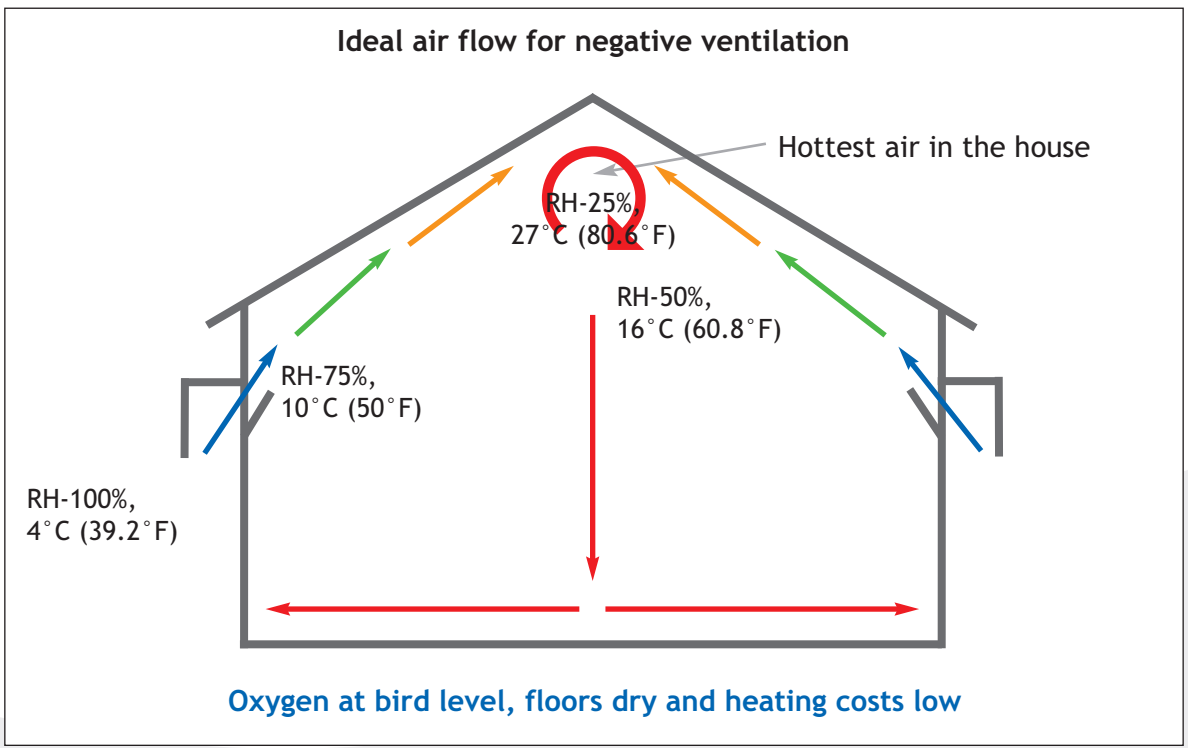
3.1. Ventilation

- Minimum ventilation controls oxygen levels via fans and inlets and must work on a timer, independent of temperature. It works any time the house temperature is at or below the house set temperature.
- The timer should provide a minimum air exchange value of 12.5% (1/8) to 20% (1/5) of house volume. The minimum run time needs to be 60 seconds to ensure that the incoming cold, outside air has properly mixed and heated with the internal air.
- Inlets are vital in achieving good air volume an distribution.
- The inlets should completely seal when closed.
- The inlets should react to the fans and work on pressure, NOT on percentage of opening or temperature.
- The inlet capacity should match the fan capacity at the fans working pressure based on the width of the house.

3. Brooding

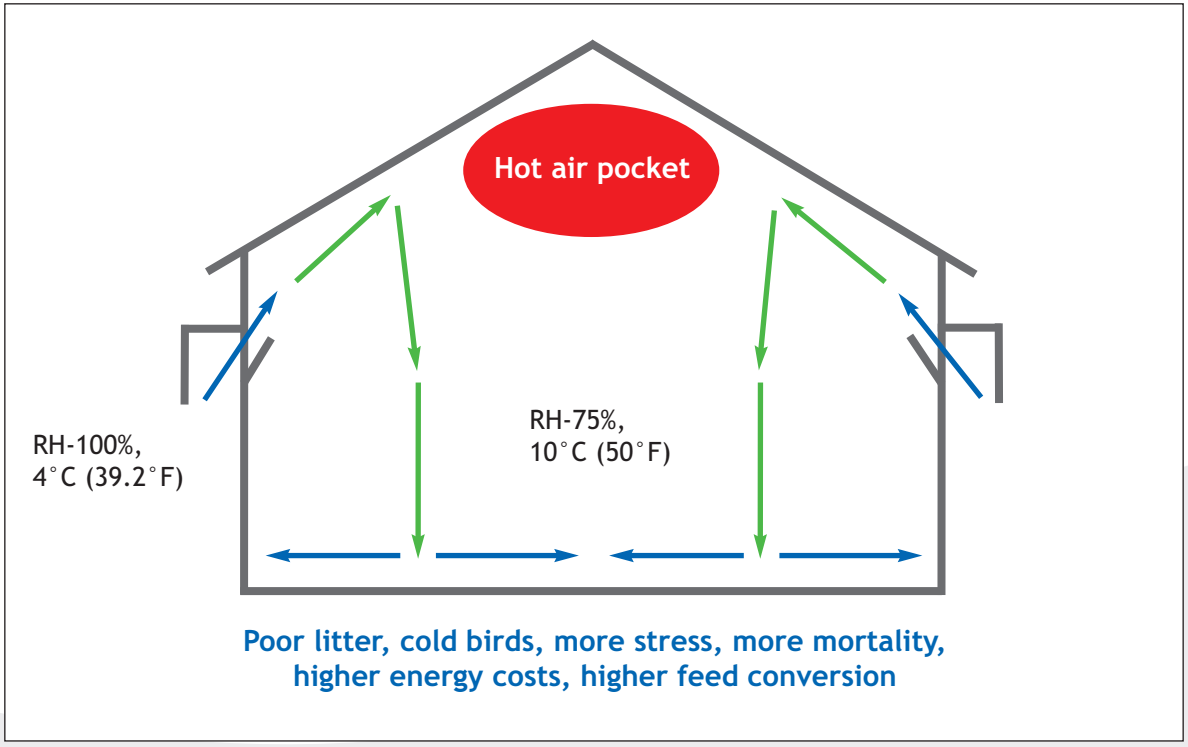
3.1. Ventilation

- The inlet needs to open at least 5cm (2 inches) to ensure good air mixing in the house.



3. Brooding

3.1. Ventilation



3. Brooding

3.1. Ventilation

Pressure scale complete

House width - meters (feet)	Negative pressure - pascal's (inches of water)	Air speed across inlets - m/second (feet/minute)	Distance travel before drop - meters (feet)
10 (33)	8.0 (.032)	4.00 (787)	6.00 (20)
15 (50)	15.0 (.060)	5.00 (984)	7.50 (25)
18 (60)	21.5 (.086)	6.35 (1250)	9.00 (30)
21 (69)	25.0 (.100)	7.50 (1475)	10.50 (34.5)
24 (79)	37.0 (.149)	8.00 (1575)	12.00 (39.4)

3. Brooding

3.2. Relative humidity

Controlling relative humidity

- The main aim of controlling relative humidity is maintaining dry friable litter.
- Wet litter will lead to increased carcass issues such as podo-dermatitis and hock burn and in extreme situations even breast blisters.
- Carcass downgrades is also used as a measurement of bird welfare. Failure to meet minimum requirements will lead to reduced allowable stocking density.
- Moisture is produced by the heating system, drinking system and the birds.
- To control relative humidity the only option is to increase the air temperature - approximately for every 1°C (1.8°F) we heat the air the relative humidity of the air is reduced by 5%.
- Warm air is lighter than cold air and the warmest air in the building is closest to the ceiling.

  The longer we can keep the outside cold air close to the ceiling the better the opportunity of increasing the temperature of that air and therefore reducing its relative humidity.
- The lower the relative humidity of the air at any temperature the larger the potential of that air to carry (soak up) moisture from the environment.

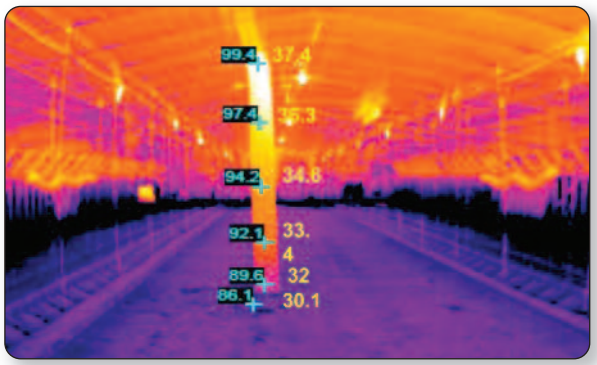
3. Brooding

3.2. Relative humidity

How to keep floors dry

- Reduce relative humidity!
- 1°C (1.8°F) increase in air temperature = 5%RH reduction.
- Heated air expands and holds more moisture.
- The warmer the temperature the bigger the bucket/sponge to remove moisture.
- The best result in reducing air relative humidity is when there is a big difference between inside and outside temperature.
- Better reduction in relative humidity - winter time, during brooding and in cold climates.
- Less effective reduction in relative humidity - summer time, when the birds are older and in warm climates.

The warmest air is closest to the ceiling



Reduction in RH% when air is heated to 30°C (86 °F)

°C (°F) @ 100% RH	New %RH
0°C (32°F)	15
3°C (37°F)	19
5°C (41°F)	22
7°C (45°F)	25
10°C (50°F)	30
12°C (54°F)	34
15°C (59°F)	41
20°C (68°F)	56

3. Brooding

3.3. Temperature

- Chick internal temperature should be maintained at 40.4°C - 40.6°C (104.7°F – 105.1°F). The temperature should be measured gently inside the cloaca.
- Chicks lose 3 grams of moisture from the feathers which act as a cooling mechanism.
- Chick internal rectal temperature should be measured after the chicks dry and internal body temperature is stabilised.
- Chick internal temperature above 41°C (105.8°F) will lead to panting.

- Chick internal temperature below 40°C (104.0°F) is too cold.

3.3. Temperature

Cold Chicks

- Floor temperatures are critical for the first two weeks as the chicks tend to lose significant heat through their feet.

3. Brooding

3.3. Temperature

- Pre-heat house for 48 hours before chicks arrive, with brooding temperatures stabilized for 24 hours before placement to heat the litter and house temperature to 32˚C (90˚F) (blow type heaters) and 40.5˚C (105˚F) (for radiant heaters - under the brooder) providing a minimum concrete temperature of 28˚C (82.4˚F).

Cold floor temperatures - lack of pre-heating

3.3. Temperature

- The minimum temperature for the first 14 days should not fall more than 1°C (1.8°F) below the set point.
- Ensure heaters have been serviced.
- Calibrate sensors before placement.
- Ensure you have adequate heating capacity.
  - Radiant heating - ensure the correct number of chicks per heater.
  - Forced air heating - where winter outside minimum temperatures are above 0°C (32°F) at least 0.05kw/hour per cubic metre (35.3ft^3) of house volume is required, and where the outside temperature is below zero, 0.10kw/hour per cubic metre (35.3ft^3) of house volume heating capacity.
- Install back up thermometers' to confirm environment.
- Place sensors at bird height.
- Chicks from pre-peak breeder flocks are smaller and have a higher need for external heat to maintain their optimal body temperature, smaller chicks have increased surface to body weight ratio and body heat loss will be more.

Infrared thermometer to check floor temperatures

3. Brooding

3.3. Temperature

Temperature guide

Age days	Relative humidity %	Temperature °C (°F) (for chicks from 30 week old parent flocks or younger)	Temperature °C (°F) (for chicks from 30 week old parent flocks or older)
0	30-50	34 (93.2)	33 (91.4)
7	40-60	31 (87.8)	30 (86.0)
14	40-60	27 (80.6)	27 (80.6)

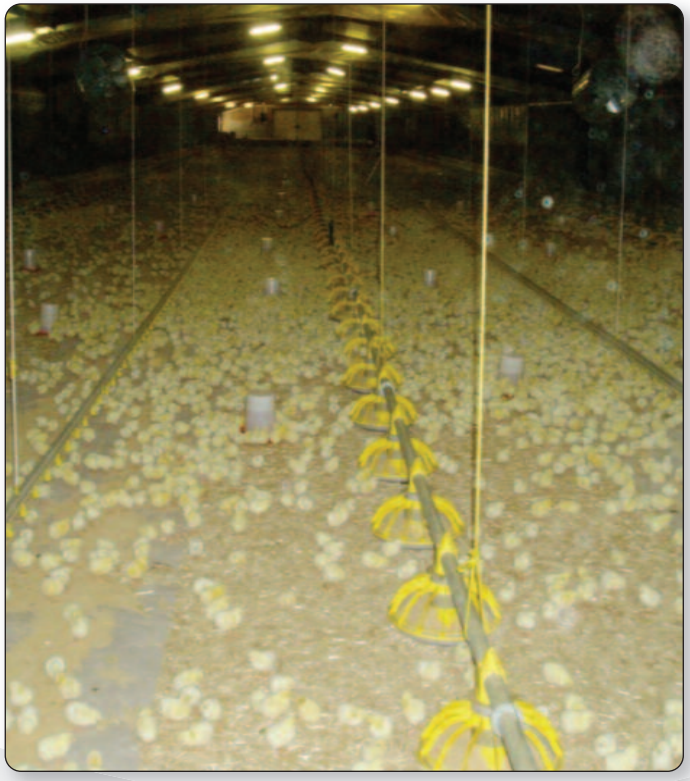
Effect of varying brooding temperatures on male and female broiler performances at 42 days of age

Parameter	32°C (89.6°F)	27°C (80.6°F)	24°C (75.2°F)
Bodyweight gain at day 7 in g (lbs)	138 (.30)	129 (.285)	121 (.266)
Final bodyweight in g (lbs)	2336 (5.15)	2298 (5.07)	2258 (4.98)
Feed conversion	1.803	1.829	1.862
Average daily gain in g	55.6	54.7	53.8
% culls	0.42	2.92	3.75
% ascites	1.67	1.67	5.00
% total mortality	2.92	5.83	8.33
Increased cost vs control	0.00	0.78	1.66

3.4. Feeding

- Feed space using paper covering minimum 50% of the floor area.
- Paper used should be news type paper and not tissue paper to ensure adequate time for feeding before the paper breaks down.
- Feed amount on paper at placement (one application), minimum 50g per chick (1.1 pounds/100 chicks).
- A line of paper should be placed at each side of each drinker line used in the house.
- The automatic feeding system should be placed on the concrete floor or down in the litter to make access to the feeding system as easy as possible for the chicks.
- The feeding system should be set on over flow for chick placement (if possible).
- On each entry to the house during brooding the feed lines should be manually run to stimulate feed intake.

3.4. Feeding



Closed housing - whole house brooding

Curtain housing - partial house brooding

3. Brooding

3.5. Water

- Water spillage and wastage should be kept to a minimum especially in winter time because of lower air exchange during these months.
- Ideally at placement a bead of water should be visible on the end of the nipple to encourage water consumption-this is achieved by setting the pressure low in the drinking system. After the first hours and once you are sure that water consumption has been adequately achieved in the flock, turn the pressure setting in the drinking system up to prevent spillage and wet litter.
- Chicks should not be encouraged to drink from the drip trays after the first day of placement - this water easily becomes contaminated from the environment and wasted onto the litter.

- Water consumption of 1 ml/bird (3.4 oz/ 100 chicks) per hour for the first twenty four hours after placement - minimum.
- Maintain litter moisture between 25-35% under the drinking system, reduce pressure if litter becomes damp.
- Place drinker lines at a height that the birds have to stretch slightly to reach.
- Ideal water temperature is between 10-14°C (50-57°F), however birds can tolerate a wide range of water temperature; even so water temperature should never be allowed to be less than 5°C (41°F) or greater than 30°C (86°F). If this occurs the drinking system must be flushed.

3. Brooding

3.6. Lighting

- Light intensity - at least 25 lux in the darkest place at floor level.
- Light intensity should not vary by more than 20% from brightest to darkest place at floor level.
- Fluorescent lights should be installed at a minimum of one watt/m^2 (10.76 ft^2) of floor area.

3.7. Chick check

The main objective of management during the first hours after placement on the farm is to achieve as much intake of both feed and water in as many chicks as possible.

Failure to achieve this objective will lead to irreversible compromised flock performance and will express itself as poor growth-poor feed conversion and poor flock uniformity.

- An excellent indicator of floor temperature is the temperature of the chick's feet.
- If the chick's feet are cold, the internal body temperature of the chick is also reduced.
- Cold chicks will be seen huddling with reduced activity and resulting in reduced feed and water intake and therefore reduced growth rate.
- By placing the feet against your neck or cheek one can readily learn how warm or cold the chick is.
- If they are comfortably warm, the chicks should be evenly and actively moving around the brooding area.
- If the crops of the chicks are checked eight hours after placement a minimum of 85% of examined chicks should have both feed and water present.
- A minimum of 95% of the bird's crops should be filled upon examination the morning after placement.
- Sample 100 chicks per brood area.
- Check: temperature of feet against neck or cheek.
- If the feet are cold, re-evaluate pre-heating temperature.
- Evaluate crop fill and indicate results on form as below:

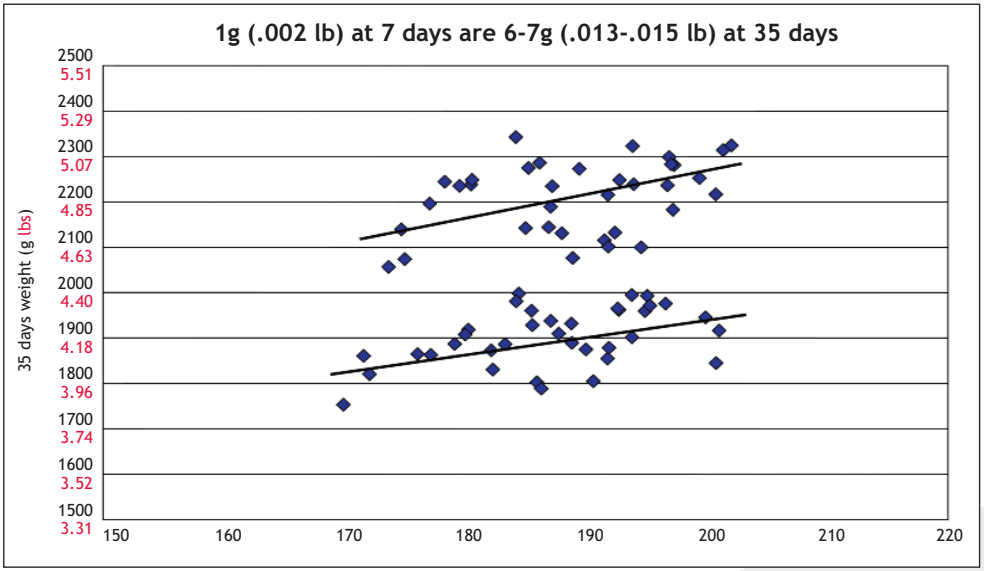
Crop fill	No. of chicks	Full - Pliable *Feed & water*	Full - Hard *Only feed*	Full - Soft *Only water*	Empty
Evaluation					

3.7. Chick check

4. Ultimate performance indicators

4.1. 7-day mortality/weights

- Mortality percentage is a good indicator of chick quality, hatching process, house set up and early brooding management.
- **Maximum seven day mortality should not exceed 1% cumulative.**
- Measuring seven-day weights will give an indication of how successful the brooding management has been.
- Failure to achieve good seven-day weights will mean an inferior result at the end of the growing cycle.
- **An extra gram (.002 lb) of bodyweight at seven days of age will yield 6 grams (.013 lb) extra at 35 days of age.**



- **The objective is to achieve four to five times the day old weight at seven days of age.**

4. Ultimate performance indicators

Glossary

Glossary

Key Factors	Targets
Carbon dioxide	<3,000 ppm
Chick box temperature	32°C (89.6°F)
Chick cloaca temperature	40.4-40.6°C (104.7-105.1°F)
Chick feathers at placement	Closed
Chick vitality	When turned on their backs should stand up in 2-3 seconds
Crop fill-at twenty four hours after placement	95%
Egg shell	Minimum amount of meconium present
Egg shell temperatures	37.8-38.1°C (100-100.5°F)
Embryos hatching too early	Hatch window – max. 25%, 24 hours before pull
Feed area	50% of floor area minimum
Feed on paper	50-65g (.11-.14 lbs)/chick at placement
Heating capacity	0.05-0.1kW/cubic metre (35.3ft^3) of house volume
House pressure test	>37.5 Pascal's (.15 inches of water)
Light intensity	25 lux at floor level
Litter moisture level	<35%
Litter temperature forced air heating	32°C (89.6°F)
Minimum inlet opening	5cm (2 inches)
Pre-heating before placement	48 hours
Radiant litter temperature under heater	40.5°C (104.9°F)
Seven day weight	4-5 times day old weight
Seven day mortality	<1%
Shank length	>3cm (1.2 inches)
Water consumption for the first twenty four hours	1ml (.034 oz)/chick/hour
Water temperature at placement	10-14°C (50-57.2°F)
Yolk free body mass chick weight	>90%

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