# Care of the egg: from nest to farm store 9



*By Gerd de Lange, senior poultry specialist, Pas Reform Academy*

A healthy, well managed breeder flock, receiving a balanced feed ration, will produce good quality hatching eggs. At the moment an egg is laid, it contains an embryo of 30,000-60,000 cells.

At that point in time, each cell is already programmed for its future function. With the best of care, the hatching potential held in this delicate embryonic structure will be fully realised. But get it wrong – and much can go amiss between nest and farm store.

Although the exact level of the so-called 'physiological zero' is debated by hatchery specialists and researchers, there is a general consensus that embryonic development, which starts in the hen's body, will continue as long as internal egg temperature is more than 25-27 °C.

Ideally, eggs should be cooled down uniformly and gradually from body temperature to between 18 and 25°C in 6-8 hours. However the rate of cooling depends on several factors.

Nest type in relation to frequency of egg collection plays an important role. Eggs produced in manually collected litter nests cool down very slowly to environmental temperature, due to the insulation provided by the surrounding nest litter.

Since nest boxes are shared between 5-7 hens, warmth is brought to partially cooled down eggs again every time another hen enters the nest. It is only once eggs are collected, that they are able to cool down properly.

In automatic nests, the eggs roll away to an egg transport belt soon after being laid, which exposes all the eggs to a similar environmental temperature.

Egg temperature at the moment of collection will vary from egg to egg, with some still holding a temperature of more than 25°C.

In this case, further cooling is required. A newly produced egg, with a temperature close to that of the hen's body (41°C), will take much longer to cool down when placed at the centre of a pulp tray and covered by the next full tray, than an egg placed at the side of the pulp tray.

Ensuring that there is an adequate supply of free circulating air over the trayed eggs will greatly assist in providing uniform cooling.

And there are further considerations when seeking to maintain the quality of the eggs after oviposition. For example, too many eggs in a nest leads to an increased incidence of hair cracks, with a negative effect on hatchery results.

Hair cracks can also result from over filling the egg transport belt, which causes the newly laid eggs to bump against each other.

Nest hygiene, too, is important for the avoidance of contamination. Floor eggs are a hotbed of infection in the hatchery, affecting both hatchability and chick quality, with further reaching effects also extending to increased first week mortality and reduced performance in the receiving farms.

## Advice

- Handle eggs with care at all times.
- Avoid shocks and jolts in handling. Remember that not only is the shell fragile, but also that inside exists an equally fragile embryonic structure!
- Collect eggs from manual litter nests at least four times per day.
- Collect eggs from automatic roll away nests 2-3 times per day, ensuring that temperature on the egg transport belt is 18-22°C.
- Maintain a temperature of 18-22°C in the egg collection room, to prevent eggs cooling down too quickly or warming up again.
- Maintain good nest hygiene at all times. Close the nests during the night, and ensure that they are opened again before the start of egg production the next morning.
- Avoid floor eggs, which should not be incubated, by good management practice that starts from the rearing period.
- Allow sufficient airflow over the eggs after collection to ensure uniform cooling. This is best achieved by collecting eggs on setter trays. Eggs should never be packed in cardboard boxes before they have cooled down.
- Further avoid hair cracks by using well designed trays, without sharp edges, that adequately support the eggs. Do not use sloppy trays and avoid overstacking. ■

# Hatching egg transport 10

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*By Gerd de Lange, senior poultry specialist, Pas Reform Academy*

Breeder farms are often situated away from the hatchery. The distance between the two sites therefore becomes an important consideration when planning the transfer of eggs to the hatchery.

Typically, deliveries vary from daily to not less than twice weekly, as increased storage time has a negative impact on hatchability and chick quality.

Egg transport is generally by truck, although when importing hatching eggs, air transport may also be used. When flying eggs, it is worth remembering that delays can occur during transfer from aircraft to truck and while waiting for customs clearance.

Because hatching egg transport is actually a period of transition from the farm store to the hatchery egg store, it is important that climatic conditions are kept optimal, to maintain hatching potential as much as possible. Ideally, temperature inside the truck should be equal to temperature in the farm store.

The cooling down of newly loaded eggs should always be avoided, especially if the vehicle is already loaded with eggs from other farms. When eggs cool, the volume of albumen and yolk shrinks, thus increasing air cell volume, which will allow contaminated air to be sucked into the egg.

Conversely, if the temperature in the truck is higher than in the store, the risk of 'sweating' (condensation forming when the colder surface of the egg is exposed to humid air) increases. Even when store and truck temperature is equal, sweating can still occur during loading and unloading, especially on warm and humid days. In such a case, a higher on-farm storage temperature of 23°C instead of the generally recommended 18-20°C can be considered. Bourassa et al (2003) found that this will produce equally good hatching results, while minimising sweating during loading.

Egg temperature can change rapidly when loading, especially when air velocity is high. This mainly affects eggs on plastic or setter trays, but it is also true for eggs on pulp trays – placed at the side of a buggy. Using buggy bags can delay temperature changes in a situation like this. But avoid direct sunlight on the bags! In a very short time, the temperature under the plastic can rise to 50°C!

To avoid negative affects on embryo vitality during transportation, sudden temperature changes, shocking and jolting should be avoided at all times.

## Advice

- Adjust vehicle temperature to that of the storage rooms of all supplying farms. The hatchery should play a coordinating role.
- Reduce the risk of sweating by reducing relative humidity in the vehicle. Providing transport time is not longer than 12-24 hours, the effect on the quality of hatching eggs is negligible.
- Avoid sudden temperature changes during loading and unloading. Connect the truck directly to the storage room whenever possible or consider using buggy bags – especially in situations of high air velocity and low air temperature. Always avoid direct sunshine and watch for unwanted condensation forming under these bags.
- Ensure a constant and uniform climate during egg transport.
- Always avoid unnecessary delays.
- Avoid shocks and jolts during loading and transport – use trucks with good suspension and trolleys with shock absorbing wheels. Maintain access roads to farms and hatchery in good condition.
- Adequately support eggs in well designed trays without sharp edges. Do not use sloppy trays and avoid overstacking.
- Always transport eggs small end down, to avoid loose air cells.
- Use temperature loggers during transport to record any temperature fluctuations.
- Take internal egg temperatures at different locations within each batch received at the hatchery, to check temperature conditions during transport.
- After transportation, rest the eggs for at least 12 hours before starting incubation. Immediate setting will increase early embryonic mortality.
- Clean and disinfect all transport equipment prior to any egg transport, to avoid pathogenic spread. ■

Elevated Egg Holding Room Temperature of 74°F (23°C) Does Not Depress Hatchability or Chick Quality (2003).
D. V. Bourassa,* R. J. Buhr† and J. L. Wilson*
*Poultry Science Department, The University of Georgia, Athens, Georgia and
†Poultry Processing and Meat Quality Research Unit, Richard B. Russell Agricultural Research Center, USDA, Athens, Georgia.

# Pre-heating – an effective tool for chick uniformity

# 11

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***By Dr Marleen Boerjan, Director Research & Development, Pas Reform***

Modern poultry management for meat production aims to deliver uniform birds to the slaughterhouse. Hatchery practice plays an important role, because success at farm level is greatly enhanced by the receipt of chicks with uniform growth potential.

The hatchery manager using modular single stage incubators with a pre-heating function has a distinct advantage, because he or she has the necessary tools to effect a uniform start for every embryo in the incubation cycle.

Preheating brings the eggs to a uniform temperature of 25°C (77°F) in an operating setter, prior to the onset of incubation.

This is the first step towards achieving a short hatch window – and therefore a uniform hatch. In the absence of a pre-heat function on the incubator, eggs can be pre-warmed by placing filled setter trolleys in the setter room.

The hatchery's key aim should be to provide an even, uniform start for all embryos placed in incubation. Preheating makes such a difference, because it minimises variations in embryo temperature at the moment when air temperature inside the incubator reaches 38.0°C (100.4°F) set point.

Variations in egg temperature will be further reduced when eggs are sorted by weight and when incubators with higher heating capacity are used, to ensure a uniform start of embryonic development for all the eggs placed inside.

Eggs from different batches are often set in the same incubator, either because the eggs have originated from different farms, or because eggs from different production days have been stored until there are sufficient to completely fill the setter.

Between batches, egg temperatures can differ – especially when, for example, setting is planned for the date of delivery for some, mixed with others taken and set directly from the hatchery cold store.

Variation in egg temperature will also occur as a result of taking eggs from the storage room at different times for loading into the setter.

Table 1 (below) illustrates that without the benefit of preheating, variation in eggshell temperature is greater after several hours of heating at incubation set point, especially when using an incubator with a lower heating capacity.

Preheating starts off low level cellular processes in some of the embryonic cells.

These processes should not be interrupted or halted in any way once they have begun and preheating must be followed immediately by incubation at a setpoint of 38.0°C (100.4°F) to achieve optimum embryonic temperature of 37.8°C (100°F).

## Advice

Preheating eggs prior to incubation is an advantage when seeking optimum chick uniformity.

For this reason, modular, single-stage incubation and high heating capacity are also recommended.

● **For incubators with a pre-heating programme:**
Use the pre-heating programme for the most uniform start to embryonic development. Starting the incubation cycle after internal egg temperature has reached 25°C (77°F) (5-6 hours after preheat begins) reduces the risk of early mortality.

● **For incubators without a pre-heating programme:**
Pre-warm eggs to 25°C (77°F) in the setter room for a minimum of 12 hours. Trolleys loaded with eggs should be separated to ensure warm air circulates properly to all eggs. ■

| Range of egg temperatures before setting | 10 hours heating with 2500W heating capacity | | 7 hours heating with 4000 W heating capacity | |
|---|---|---|---|---|
| | No preheat | +5 hours preheat | No preheat | +3 hours preheat |
| 14-20°C | 33.2-37.8°C | 34.6-37.8°C | 35.5-37.8°C | 37.3-37.8°C |
| 57.2-68°F | 91.8-100°F | 94.3-100°F | 95.9-100°F | 99.1-100°F |

*Table 1. Range in egg temperatures after heating with or without preheating in incubators with two different heating capacities. Egg weight varies between 50-70g.*

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# To candle or not to candle, that is the question . . . 12

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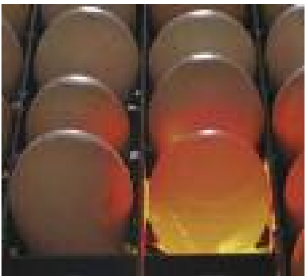
During the incubation process, eggs are candled to determine the number of infertile eggs and eggs with dead embryos, together indicated as 'clears'.

This can be done as early as day 5-6 of incubation by an individual candling light, but it is time consuming and the risk of candling errors (for example the accidental removal of an egg with a normal living embryo) is evident.

The risk for candling errors is reduced if candling is performed at day nine or 10 of incubation. By this time, it is also possible to use a so-called 'candling table', whereby the entire setter tray is illuminated from beneath. Using a candling table is less time consuming than using an individual candling light – though at the expense of accuracy.

This is because when the number of 'clears' is high, light escaping through the empty places – or 'flooding' – in the setter tray makes it more difficult to identify remaining clears conclusively.

In many hatcheries, it is therefore common practice to candle eggs on the day of transfer to the hatcher, as this is most efficient in terms of time and labour productivity. When eggs are checked in this way, at the point of transfer, automatic candling equipment that illuminates all eggs before the clears are removed,may be used without the disadvantage of reduced accuracy by light flooding.



There are several reasons for candling:

- Early detection of problems on breeder farms, during egg handling and incubation, especially if combined with egg break-out.
- Creating a set of hatchery specific reference data, in combination with egg break-out.
- Estimation of expected percentage viable chicks.
- Reduction of hatchery waste. In some cases, clears have a market value, whereas take off fees are incurred for waste handling unhatched eggs.
- Positive impact on hatchability and chick quality.

For the first three reasons, it is sufficient to candle a representative number of eggs set. For reasons four and five, all eggs should be candled and clears removed.

The work of Reis et al (1993) showed improved chick quality as a consequence of clear egg removal during candling, especially with older flocks. Studies by Embrex Inc. (IHP Volume 17 Number 7) also favour the removal of clear eggs during transfer and prior to in ovo vaccination.

This trend appears to be stronger in the case of older flocks, a factor also supported by the results of Pas Reform Academy's work with customers in the field, and by experienced hatchery managers.

Clear eggs transferred to the hatcher create an unstable climate in the hatcher baskets, because they do not produce metabolic heat.

When automatic chick separators are used, clear eggs are liable to break, causing 'painted' chicks.

## Advice

- Do not candle between 11 and 14 days of incubation, as this interrupts the movement of the embryo to the length axis of the egg.
- When candling on day 9 or 10, empty places on the setter tray should be filled up by moving the remaining eggs backwards to create complete rows, leaving the first rows empty.
- Remove clears when higher than 10-15% . When the percentage of clears is lower than 10%, there is no direct need to remove clears prior to transfer.
- If during candling at day of transfer more than 30 eggs are removed from a setter tray with 150 eggs, add eggs from another tray to ensure each hatcher basket is full. Ideally, eggs should touch each other while laying in the hatcher basket; it seems the vibrations caused by first chicks to pip are a trigger for other chicks to start pipping as well.
- Record the number of clears and consider running an egg break-out on a representative sample. ■

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# Finding the optimum incubation temperature

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*By Dr Marleen Boerjan, director research & development, Pas Reform Academy*

When a hatchery manager talks about incubation temperature, he or she refers to the temperature set point at the controller of the incubator. This temperature set point regulates the temperature of the air stream along the incubator's temperature sensors. If the air temperature is too high or too low, the incubator controller adjusts the cooling or heating rates respectively, until temperature set point is reached. Thus, incubation temperature is dictated by the air temperature surrounding the sensor. However the manager knows that there is a critical relationship between incubation temperature, hatchability and chick quality.

## Optimum egg shell temperatures

The key parameter for achieving optimum embryonic development is embryonic temperature, represented by the temperature of the egg shell.

From recent research, we know that shell temperature should ideally follow a natural pattern (see Fig. 1).

During the first 12 days of incubation, optimum shell temperature is 37.8±0.1°C (100±0.2°F), followed thereafter by a gradual increase to 38.4-38.6±0.2°C (101.1.-101.5±0.4°F) at day of transfer.

From practical experience, we also know that during the first 12 days of incubation, optimum shell temperature varies little between embryos from different poultry strains.

Towards the end of the incubation period, however, there are significant variations in the optimum maximum shell temperature for different strains: normal maximum shell temperature for the classic breeds are too high for embryos from modern high yield breeds, resulting in poor quality chicks with poor navels and red dots on the beak.

## Optimum incubation temperatures

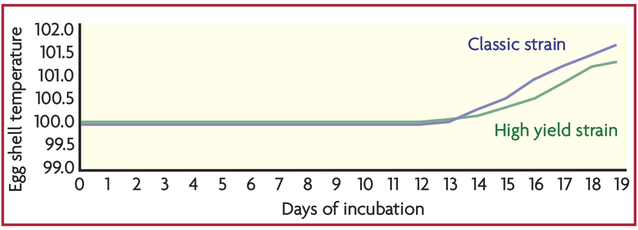
Egg shell temperature is determined by a combination of the metabolic heat produced by the embryos and the climate (temperature, air flow, humidity) surrounding the eggs. In the early phase of embryonic development, very little metabolic heat is produced and the air surrounding the eggs should be heated to keep egg shell temperature at optimum levels.

But towards the end of incubation, the production of metabolic heat increases – and this heat must be removed by cooled air flowing over the eggs to avoid the risk of overheating the developing embryos.

## Advice

- Define optimum incubation temperatures by measuring the egg shell temperatures of a representative sample of eggs, randomly chosen from different trays in the incubator.
- Do not copy guidelines for optimum incubation temperatures from one brand of incubators to another. Airflow patterns differ between different incubator designs.
- Limit the number of trolleys in front of the fan or air pump to a maximum of two. This guarantees a uniform airflow and even temperature distribution over the eggs.
- Use chick quality as a reference, especially if egg shell temperatures cannot be measured at a regular base.
- Perform a detailed analysis of chick quality (Pasgar score) to avoid accidental conclusions on overheating. If ≤50% of chicks have a fully closed, normal navel and 10% of chicks have a red dot on the beak, reduce the incubation temperature.
- Increase incubation temperatures if day old chick quality indicates an incubation temperature that is too low. This applies if ≤50% of chicks have a fully closed normal navel and 20% have a thick belly (large yolk sac), upon detailed analysis of chick quality (Pasgar score). ■

*Fig. 1. Natural pattern of egg shell temperatures for optimum hatchabilities and chick qualities.*

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# Hatchery management changes with single stage incubation

# 14

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Management in a multistage hatchery is based on a daily routine of setting eggs according to a strict setting schedule per setter type.

The common principle for establishing a setting schedule in a multistage incubator is based on the need to transfer metabolic heat from more developed embryos to the less developed, heat demanding embryos in the early stage of embryonic development. Embryo temperature in a multistage incubator is mainly controlled by the pattern of alternating 'old' heat producing embryos and 'young' heat demanding embryos. The incubators are filled according to the direction of the airflow in that specific make or model of incubator. In addition, the temperature controller is fixed at a specific set point. Embryo temperature is thus only supported approximately in multistage incubators.

Management in the multistage hatchery cannot accommodate egg quality or the needs of the growing embryo. However, it is becoming increasingly clear that today's modern breeds need a more accurate approach to incubation to achieve high numbers of good quality chicks that fully realise their genetic potential (Fairchild et al, 2007).

Furthermore, the multi-stage incubator cannot easily be cleaned – because it is never empty.

For these reasons, more and more hatcheries are making the transition from multistage to single stage incubation management. Single stage incubation runs specific incubation programs such that the climate in the incubator is programmed to match the specific needs of the developing embryos. Single stage incubators can also be cleaned after each incubation cycle and thus meet high hygienic standards of today's food production industry.

Often, the transition from multistage to single stage incubation is initiated by the replacement of aged multistage incubators by new single stage equipment, without an awareness that hatchery management too will need to be adjusted.

Management in a single stage hatchery is certainly not based on a routine, but rather adjusted to accommodate the needs of a specific egg type. Consequently, hatchery managers need to learn about variation in needs of embryos from different egg types, as defined by strain, flock age and the duration of storage.

## Advice

- Plan size of setters in accordance with size of batches of eggs. A batch of eggs is the total number of eggs produced on a specific day by one flock in one farm.
- Create an overview of the egg types incubated in your hatchery.
- Do not mix different batches of egg types, if separating egg types for incubation is not possible.
- Fill setters with batches of eggs that have similar characteristics with respect to strain, flock age and days of storage.
- Avoid filling one incubator with eggs from flocks more than five weeks apart in flock age.
- Avoid filling one incubator with eggs from one flock but with more than five days' storage difference.
- If the incubator has to be filled with more than one batch of eggs, do not combine fresh eggs with eggs stored for more than five days.
- Follow manufacturer's guidelines carefully when starting the first incubation cycle in the single stage incubator.
- Keep records for each incubation cycle, per egg type used and showing the different management steps taken per type.
- Use data with respect to hatchability, incubation time and chick quality from recording forms to fine-tune your incubation programs.
- Train hatchery personnel so that they are fully advised regarding the different management steps required when using single stage practices.
- Highlight the need for change: make sure hatchery personnel understand that single stage management requires a different approach to multistage management to succeed. ■

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# Managing the hatch window

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*By Gerd de Lange, senior poultry specialist, Pas Reform Academy*

The term 'hatch window' is used to describe the time span between the hatching of the first and the last chick in one particular hatcher.

However, in practice, because it is impossible to look inside each and every hatcher basket without compromising the hatcher climate, the hatch window is estimated rather than measured precisely.

If the hatcher has a window, the measurement of the hatch window begins with sight of the first chicks. Another good indication is an increase in relative humidity.

Once the first 5-10% of chicks emerge from their shells, the moisture on their bodies quickly evaporates, which drives relative humidity upwards spontaneously.

It is possible to stop and open the hatcher at, for example, minus 36, 24 and 12 hours before planned chick take-off, to estimate when the first chicks appeared. But this method does interfere with climatic conditions, and estimations are often crude, based on observations from a sample of hatcher baskets by quickly opening the hatcher.

Using this method, timing the appearance of the last chick will often vary from hatchery to hatchery.

And consider too: the last chick may never in fact hatch in the case of, for example, an externally pipped egg – complete with a still living, fully developed embryo – that fails to finish the job due to malpositioning.

Chicks do not hatch at exactly the same time. Even if two hatching eggs receive the exact same pre-incubation and incubation treatment, they still may differ a few hours in incubation time, because of natural variation in embryonic development.

In normal day-to-day practice, eggs placed together in one particular hatcher almost certainly do not have the same history.

Factors like egg size, flock age, post-lay egg cooling profile and storage times do all have an effect on incubation time.

The most crucial factor for the rate of embryonic development – and thus determining incubation time – is temperature.

The hatchery manager must ensure that hatching eggs have the same or very similar characteristics before placing them in the incubator.

Once inside, uniform conditions, especially uniform temperature distribution, are essential to achieve a short hatch window.

With good management and modular, single-stage equipment, it is possible to achieve a hatch window of 12-24 hours for broilers.

In any case, the hatch window should not exceed 24 hours. This prevents dehydration in chicks that hatch first. Subsequently, ensuring that all the chicks – from first to last in the hatch – gain access to their first feed at the same time – or as closely as possible to simultaneously, is important for maintaining post-hatch uniformity.

Careghi et al. (2005) showed that delaying access to feed after the hatch depresses the relative growth rate of chicks differently for early versus late hatched chicks.

When using modular single-stage incubation methods, the hatch window for commercial layers is usually even shorter than for broilers, at just 8-12 hours.

## Advice

- Fill the setter with similar batches of eggs pertaining to breed, maternal age, egg size and storage time.
- Transfer batches of eggs from one big setter to several smaller hatchers, keeping each batch with similar characteristics within one hatcher.
- Preheat eggs for 5-8 hours at 25°C (77°F) in the setter. Alternatively, pre-warm eggs in the setter room for a minimum of 12 hours, to ensure uniform internal egg temperature prior to the onset of incubation.
- Ensure fast, even warm-up to incubation temperature by using setters equipped with sufficient high heating capacity. Incubation set point should be achieved within 5-6 hours, providing eggs are properly preheated or prewarmed.
- Aim for uniform incubation conditions, especially temperature. This is best achieved in modular single stage incubators, designed for uniform temperature distribution, with the functionality to deliver different temperature set points per batch of eggs. ■

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# Managing incubation temperature to combat increased early mortality

# 16

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*By Dr Marleen Boerjan, director research & development, Pas Reform Academy*

As a breeder flock ages, the number of 'clear' (infertile) eggs increases as a result of decreased fertility and increased early mortality.

Consequently, with higher numbers of clear eggs, a higher proportion of the heat produced by developing embryos in the fertile eggs is absorbed by the 'cold' clear eggs placed around them.

Embryonic temperature in the fertile eggs is reduced by a combination of the air flowing over them, together with the 'redundant' loss of heat absorbed by the clear eggs.

To achieve optimum embryonic temperature in this scenario, we can compensate for the heat 'lost' to cold, clear eggs by increasing the temperature of the warm air flowing over the eggs.

The temperature of the air flowing over the eggs is governed by the incubator's temperature set point.

If air temperature is either too high or too low, the incubator controller adjusts cooling or heating rates respectively, until temperature set point is reached.

When there are more than an average number of clear cold eggs positioned between developing fertile eggs, incubation temperature should be raised accordingly – in line with rates of fertility and early mortality in each particular batch of eggs.

Estimates for these rates per different flock ages should be available in the hatchery's reference data, or in the breeder's management manual.

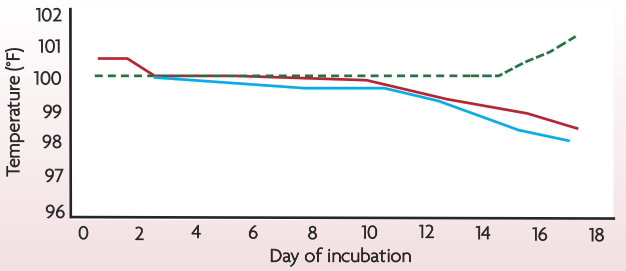
The hatchery manager knows that there is a critical relationship between embryonic temperature, hatchability and chick quality.

Incubation temperatures that are set too low will result in increased mortality and a higher number of hatched chicks with a full belly.

## Advice

- Routinely record, per batch of eggs, the percentage of clears, the hatchability of eggs set and hatchability in transferred eggs.
- Estimate the expected percentage of clears per batch of eggs. Adjust set points accordingly if this is >25% (more than 37 clear eggs per tray).
- Identify the natural patterns of egg shell temperatures throughout incubation. During the first 12 days, optimum shell temperature is 37.8±0.1°C (100±0.2°F), followed thereafter by a gradual increase to 38.4-38.6±0.2°C (101.1.-101.5±0.4°F) at day of transfer.
- Define optimum incubation temperatures by measuring the egg shell temperatures of a representative sample of eggs, randomly chosen from different trays in the incubator.
- Analyse random egg samples and use chick quality as a reference, especially if egg shell temperatures cannot be measured regularly.
- Consider increasing incubation temperatures if the air cell of dead-in-shell chicks is too small, but first, ensure that this is not caused by relative humidity being too high in the incubator.
- Increase incubation temperatures if day old chick quality indicates too low an incubation temperature. This applies if ≤50% of chicks have a fully closed normal navel and 20% have a thick belly (large yolk sac), upon detailed analysis of chick quality (Pasgar score).
- Perform a detailed analysis of chick quality (Pasgar score), to avoid reaching accidental conclusions when incubation temperatures are too cool.

*Fig. 1. Optimum incubation temperatures for a batch of eggs with 65-75% fertility (red line) and 85-95% fertility (blue line) to achieve optimum egg shell temperatures (green dotted line).*

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