# HATCHING EGG AND ENVIRONMENTAL MANAGEMENT: PART 1

This is the first of two checklists which will be useful when investigating how well your hatchery is performing, and where improvements might be made.

## EGG MANAGEMENT

Egg processing on arrival at the hatchery:
- Check eggshell temperatures on arrival [target max 1-2°C (1.8-3.6°F) higher than hatchery egg store].
- Check for condensation. Use extra fans to dry fast when necessary.
- Take representative sample trays from each batch of eggs delivered to the hatchery, and count any upside down eggs (target is less than 1%).
- Check for dirty and floor eggs. Separate these eggs and place on bottom trays, remove and discard excessively soiled ones.
- Remove cracked eggs, including hairline cracks.
- Complete egg processing without allowing egg temperature to rise. The processing area set temperature should be that of the egg store.
- Never pack eggs into boxes before they have cooled to storage temperature.

## EGG STORE MANAGEMENT

- Identify storing zones according to egg production dates for first in first out principle.
- Aim to set eggs before they reach seven days old.
- Let eggs rest in the egg store 24-48 hours after transport.
- Hold egg store temperature at 15°C (59°F) for all egg ages.
- Never put warm eggs close to cold ones, or warm trollies next to cool ones.
- Avoid temperature fluctuation by keeping doors closed.
- Avoid using humidifiers except in very dry climates, because static water reservoirs can encourage bacterial growth.
- Use circulation fans for uniform and fast egg cooling.
- Avoid packing eggs too close together; store eggs in setter trays and trolleys whenever possible.
- Turn eggs 4-6 times a day, if possible, if stored for over seven days.

## PLAN THE SET SO IT IS BALANCED

- Do not mix young/old flocks, low/high fertility or small/large eggs.
- If some mixing is unavoidable, place the eggs closest to average next to the temperature sensor.
- Alter set times according to egg age, flock age and season.
- In multi-stage setters, mark trays clearly to identify flock of origin, pick up date and set date.
- If soiled or floor eggs must be used, set them in the bottom trays or in a separate machine.
- In multi-stage machines, follow manufacturers suggested setting patterns and intervals.
- Try to set the most fertile, and largest eggs (which produce the most heat) close to the fan.
- Plan any backfilling, taking account of the cooling capacity of the setters and hatchers – very few will cope with the heat output of 100% live embryos.
- If hatching parent stock, set male line and female line eggs separately, if possible.



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# INCUBATION AND CHICK MANAGEMENT: PART 2

This is the second checklist which we hope will be useful when investigating how well your hatchery is performing, and where improvements might be made.

## SETTERS

- **Calibration**
  - Calibrate thermometers in single-stage setters every set, multistage setters every month.
  - Check turning mechanism and angles.
  - Calibrate damper openings at 0%, 50% and 100%. Avoid hot/cold spots by checking fixed dampers.
  - Calibrate $CO_2$ sensors every three months.
- **Egg shell temperatures**
  - Target 100˚F (99.5˚F- 101.5˚F) egg shell temperature of fertile eggs from day 1 to day 20.
  - Check egg shell temperatures at days 2, 15 and 17.
  - Check egg shell temperatures in different positions to identify hot/cold spots.
- **Weight loss**
  - Target 10.5-12.5% weight loss from lay to 18 day transfer.
  - Calculate target weight loss for every set, accounting for weight loss during egg storage.
  - Alter RH% set points to meet the target.

## TRANSFER

- Transfer on day 18 (19 if vaccinating in ovo).
- Keep eggs warm – waiting time <15 minutes.
- Candle/remove infertile and early dead embryos.
- Backfill baskets to balance the number of live embryos across the hatcher.
- Evenly distribute eggs across the hatcher basket.
- Transfer eggs gently to avoid damage.

## HATCHERS

- **Calibration**
  - Calibrate temperature and humidity sensors monthly.
  - Calibrate $CO_2$ sensors every three months.
- **Set points**
  - ≤98˚F after transfer and ≤97˚F at the end.
  - If a constant set point is unavoidable, use 97.5˚F.
  - Adjust set points according to estimated chick numbers.
  - Avoid hot/cold spots by not using humidifiers.
- **$CO_2$ levels**
  - Avoid high $CO_2$ set points at the end of hatch.
  - Monitor hatches with a wider hatch window carefully.
- **Hatch window**
  - Observe hatch window and investigate problems.
  - Keep window below 30 hours.
- **Pull and cleaning**
  - Keep hatcher doors closed and fans running until all chicks are out.
  - Empty all hatchers in the same corridor before cleaning.
  - Close hatcher doors during pulling, unless passing through them.

## CHICK PROCESSING

- If banger numbers are high, unload by hand to avoid spreading contamination.
- Check belts, conveyors, needles and other equipment to ensure chicks will not be injured.
- Change vaccination needles every 1,000 chicks.



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# CHICK PROCESSING AND HOLDING: PART 3

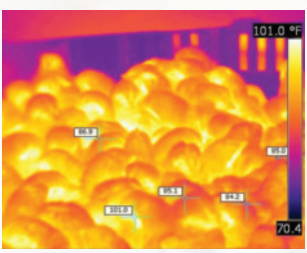
This is the third checklist which we hope will be useful when investigating how well your hatchery is performing and where improvements might be made.

## CHICK PROCESSING

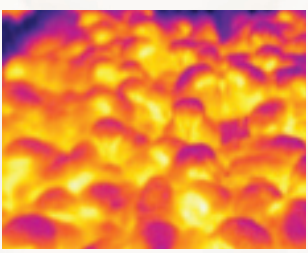
- If banger numbers are high, unload by hand to avoid spreading contamination.
- Check belts, conveyors, needles and other equipment daily to ensure chicks cannot be injured.
- Change vaccination needles every 1,000 chicks.

## CHICK HOLDING AND TRANSPORT

- Check chick vent temperatures (target 103-105˚F) in different zones every hour. Alter room temperature set point as needed.
- Adjust room ventilation rate according to chick numbers (aim for <1,500ppm $CO_2$).
- Do not place chicks beneath air inlets or in direct airflow; if they are in a draught they will become chilled.
- Plan delivery times to minimise holding duration and account for climate.
- Do not overload chick trucks.




**Chicks at a comfortable temperature, no draught.**



**Chilled chicks in a direct draught from a ceiling air inlet.**

## CHICK HOLDING ROOM VENTILATION

- Run the room at slightly negative pressure (not lower than -10pa).
- Distribute fresh air evenly and avoid temperature differences, draughts or fluctuations.
- Place stacks of boxes in an unbroken row (shown below) and use fans to create a steady air velocity in between the rows of chick boxes. This will help to maintain air speed and consistent heat removal.
- All roof circulation fans should work upward.

**A chick holding room with good layout and ventilation.**



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# HATCHERY CHECKLIST PART 4: VENTILATION

This is the fourth checklist which we hope will be useful when investigating how well your hatchery handles the needs of ventilation.

## AIR HANDLING UNITS

- Clean air ducts and filters regularly.
- Keep cooling coils clean and avoid blockages.
- Check belts regularly; change when cracked.
- Check filter change warning pressure sensors for filter condition, making sure the sensors are working properly.

## PLENUMS

- Be sure that temperature, RH and $CO_2$ levels are consistent across the plenum.
- Make sure that all access hatches are closed properly.
- If present, clean cooling coils and humidifiers regularly.

## AIR PRESSURE

- Calibrate pressure sensors and check air volumes of rooms or plenums on a monthly basis.
- Check reference points regularly.
- Use a filter attached to the reference tube outside end.
- Avoid pressure fluctuations.
- The pressure sensor range should be less than 10 times that of the target pressure for the room, as they have a 1% error of reading value. If the target pressure set point is 5pa, the sensor should have a maximum 50pa range.

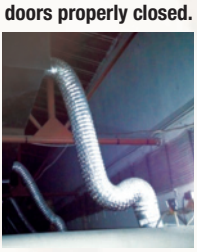
## EGG STORAGE ROOM

- The temperature of the egg store should be consistent throughout the room.
- If humidity exceeds 90%, ventilate to reduce it and avoid fungal growth.

## SETTER AND HATCHER ROOMS

- Maintain 22-28°C temperature and 50-60% RH in setter and hatcher rooms.
- Keep doors closed.
- Keep $CO_2$ levels below 1000ppm.
- Clean and maintain spray nozzles regularly if present.
- Never wash empty hatchers while the hatch continues in the same room. This can cause high humidity and a risk of contamination.
- Calibrate room/plenum inlet dampers regularly.
- Clean hatcher exhausts regularly.
- Avoid sharp angled bends in flexible exhaust ducts.

**Keep doors properly closed.**



**Avoid sharp bends in flexible ducts.**

## TRANSFER ROOM

- Aim for a room pressure less than the setter room and more than the hatcher room.
- Provide extra ventilation when using in ovo vaccination.
- Keep doors closed during transfer unless actually in use.

## VACCINE PREPARATION ROOM

- Hold at a higher positive pressure than any other surrounding room.
- Ventilate continuously.
- Use a high efficiency particulate air (HEPA) filter if possible.
- Use double slider windows for vaccine serving.



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# INCUBATION IN HIGH HUMIDITY CLIMATES

## Why is humidity important?

Moisture loss during incubation is essential to chick quality and performance. The egg needs to lose between 10.5-12.5% moisture from point of lay to 18 days of incubation.

## How moisture leaves the egg

After lay, water vapour travels through the semi permeable eggshell membrane, then through the pores of the shell and into the environment. The greater the difference in humidity between the internal environment of the egg (saturated) and the external environment, the faster moisture will leave the egg.

If there is too much moisture in the environment around the egg due to high humidity, chick quality will be compromised.

In temperate climates, even when the atmospheric humidity is high, air temperatures are relatively low, so heating the air for the purpose of incubation automatically lowers the relative humidity. However, in hot humid (tropical or sub-tropical) climates it is necessary to remove the excess humidity from the air before it is delivered to the incubators.

## How do we remove moisture from the air?

Ideally, we want to supply air with an absolute humidity of 13.4g/m³. At 15.7˚C air cannot hold more than this amount, so if the air is cooled down to 15.7˚C, the excess moisture will condense and can be removed from the air (Fig. 1). Because the air travels through HVAC system at high speed, it is usually necessary to chill the air using cooling water at 10-11˚C to ensure enough moisture is removed.

Then, the air needs to be re-warmed to prevent cold spots in the machines while ventilating. This can be done with a cross plate heat exchanger (Fig. 2). These use the hot return air from the setter to re-warm the now dry air, prior to delivery to the setter room. An auxiliary heater may also be used for supplementary heat, as necessary.

**Fig. 1. Cooling the air with a coil and droplet eliminator.**

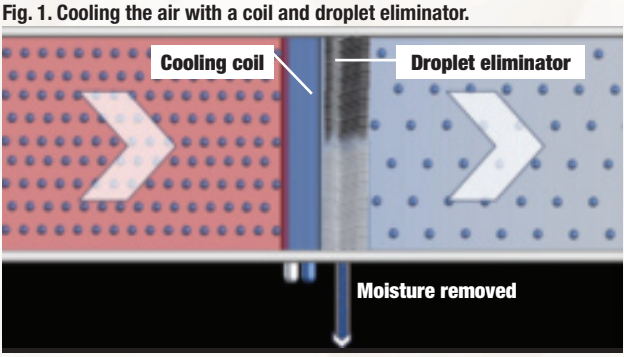
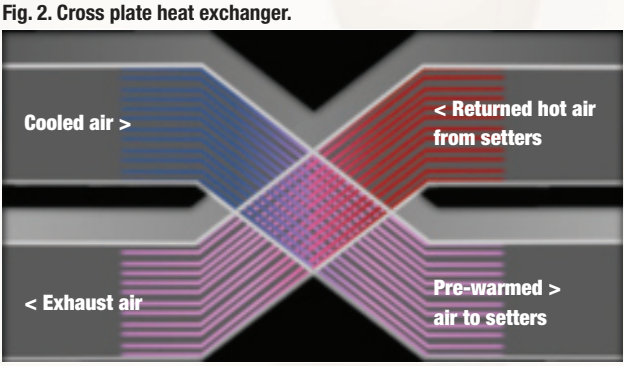



**Fig. 2. Cross plate heat exchanger.**



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# BACKFILLING HATCHER BASKETS FOR LOW FERTILITY FLOCKS

Many manufacturers have developed automatic egg candling and transfer systems that help the hatchery transfer process to be completed in an efficient and timely fashion. Unfortunately, few of them make it easy to backfill the hatcher baskets when a flock has poor fertility.

The term 'backfilling' refers to the action needed when flock fertility, defined as candled clears, falls below 75%. After the clear (infertile and early dead embryos) and contaminated eggs have been removed during the transfer process, any baskets that have fewer than 90% of eggs containing live embryos need to have added to them enough reserved candled eggs from the same flock to make up for the eggs that were removed. Thus, if the setter trays hold 150 eggs, and 25% of them are removed at candling, then each hatcher basket will need to have 22 fertile eggs added.

**50% filled and 90% filled hatcher trays (photograph taken at 507 hours of incubation).**

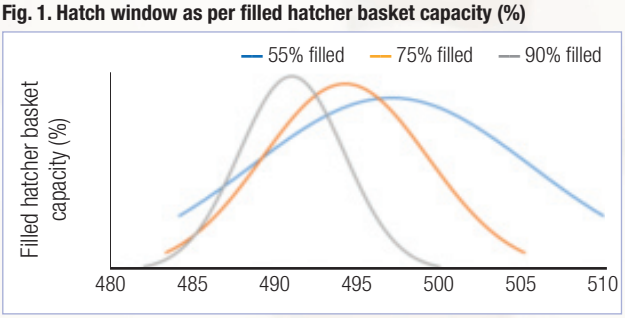
Correct and effective backfilling will maintain and enhance the metabolic heat output from each hatcher basket, reduce cold spots and tighten the hatch window in the embryos' last few days of development. Fig. 1 below shows predicted hatch spread when hatcher baskets contain 55%, 75% or 90% eggs with live embryos; it is tightest with a 90% fill, as opposed to a wider hatch spread when the baskets are only 55% filled.

Backfilling can be done by trained hatchery staff with a gentle hand packing technique or by using a portable egg lifter. It is important to place the replacement eggs into the hatcher baskets with great care. If care is not taken, there may be internal or external damage to the egg, similar to that seen with other forms of transfer damage. These can cause late stage mortality and reduce chick quality.

It is very important not to overfill the baskets. Hatchers are not designed to cope with the heat output when 100% full of live embryos, especially from older flocks with a larger egg size. Overfilled baskets also restrict airflow, which exacerbates the excessive embryonic heat output, damaging chick quality and performance.

The time and labour required will probably make backfilling in broiler hatcheries uneconomic. However, hatcheries handling high generation stock will find it a useful technique to improve the hatch window and final chick quality at hatch.

**Fig. 1. Hatch window as per filled hatcher basket capacity (%)**



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# COOLING EGGS AFTER SHORT PERIODS OF INCUBATION DURING EGG STORAGE (SPIDES)

Short periods of incubation during egg storage (SPIDES) has been implemented in many hatcheries, and has proved to be a very effective way to restore the hatch loss usually seen after prolonged egg storage. When using SPIDES, it is critical that the eggs are allowed to cool down from peak temperature quickly and evenly before they are returned to the egg store. If the eggs are above egg store temperature, they will warm the eggs around them, damaging hatchability.

When using a machine which has been designed to perform SPIDES treatments, both heating and cooling capacity are increased, and the eggs will cool properly as long as the full cycle is followed. However, many hatcheries use a standard setter to treat the eggs, and so alternative arrangements should be made to cool them after treatment.

Fig. 1 shows a thermal image of an egg store containing SPIDES treated eggs in the centre of the picture, and the warming of the adjacent eggs to the side. Although the eggs were only 24°C when replaced in the egg store, they were still able to warm eggs in adjacent trollies to a level where embryo development will continue at a level likely to harm hatchability. When transferring eggs that are still warm post-SPIDES treatment to the egg store, place them as far as possible away from any cooled eggs. A temperature logger placed on the trolley closest to the warmer eggs can record any rise in air temperature.

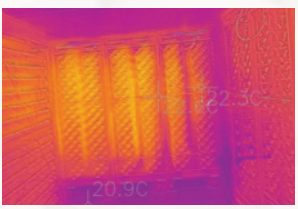
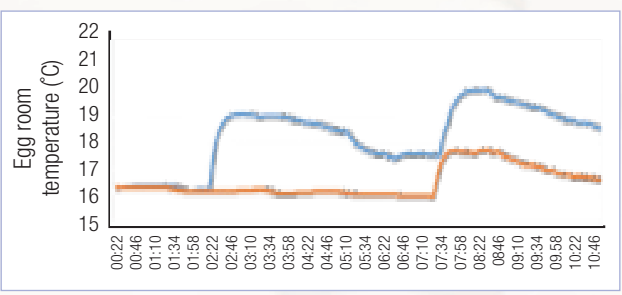



**Fig. 1. Thermal image of eggs after SPIDES treatment returned to the egg store and warming the surrounding (cool) eggs.**

Fig. 2 shows a hatchery egg store where the cooling capacity was insufficient to cool the eggs after warm eggs were added. They cooled by only 1.5°C before a second batch of treated eggs was added, at which point the temperature of the adjacent eggs increased as well.

If SPIDES is used on a routine basis, the egg store can be partitioned so that there is space dedicated to cooling eggs after treatment without damaging the other eggs. The area will need additional cooling capacity and enhanced air circulation to maximise the effectiveness of the cooling process. By using SPIDES treatments while maintaining a stable egg store temperature by implementing good management of the post-treatment cooling procedure, much better hatchability can be expected from stored eggs, even into their fourth week.

**Fig. 2. Air temperature close to SPIDES treated eggs (blue) and untreated eggs (orange) as eggs are restored to the egg store. The cooling system should be upgraded to manage regular additions of warm eggs.**



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# IS MEASURING VENT TEMPERATURE ACCURATE?

Day-old chicks cannot control their body temperature, and during the time they spend in the hatchery, are sometimes exposed to temperatures which are uncomfortable, or even actively harmful. Aviagen advises that day-old chicks be held in conditions which allow them to maintain a vent temperature between 103 and 105°F (39.4 and 40.6°C). Vent temperature is measured using a Braun ThermoScan® thermometer, holding the sensor close to the skin of the vent. It has been suggested that measuring rectal temperature by inserting a paediatric rectal thermometer about 0.5cm into the chick's vent is more accurate than measuring vent temperature. Unfortunately, it also has the potential to damage the gut wall of the chick during insertion.

Fig. 1 shows the relationship between the rectal and vent temperature of chicks which were held in a range of different thermal environments, set up to induce vent temperatures between 99 and 107.5°F (37.2 and 41.9°C). It shows a tight relationship between the two measurements, with an $R^2$ value of 0.865 (the closer the $R^2$ value is to 1.00, the stronger the relationship between the variables), indicating that the vent temperature is an accurate measure of body temperature in the day-old chick.

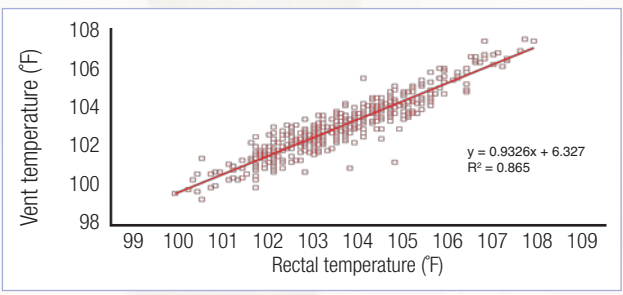


**Fig. 1. Relationship between rectal and vent temperature.**

To get the best accuracy when checking vent temperature, take the measurements where the chicks have been held, because their body temperature will adjust to a new environment quite quickly. To measure vent temperature, ensure the thermometer has a clean tip cover, pick a chick up and hold it so that you can see the vent, position the chick's rump towards you and gently push the rump upwards so that the vent is exposed, rather than covered with down (Fig. 2). Shield the chick from any draughts with your body while measuring, and ensure that the tip of the thermometer only touches bare skin. Any chicks which have a wet vent should be dried, or a different chick should be chosen for measurement.

The vent temperature measurement is the preferred method, being just as accurate and safer for the chick. Unfortunately, it is only really suitable for chicks in the hatchery – once they start to eat, drink and grow the vents are too wet to give an accurate result. However, in the hatchery, the measurement is an invaluable tool for checking a room or holding area for hot and cold spots, before taking corrective action as necessary. Your chicks will be more comfortable and resilient as a result.

**Fig. 2. Measuring the vent temperature of a day-old chick.**



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