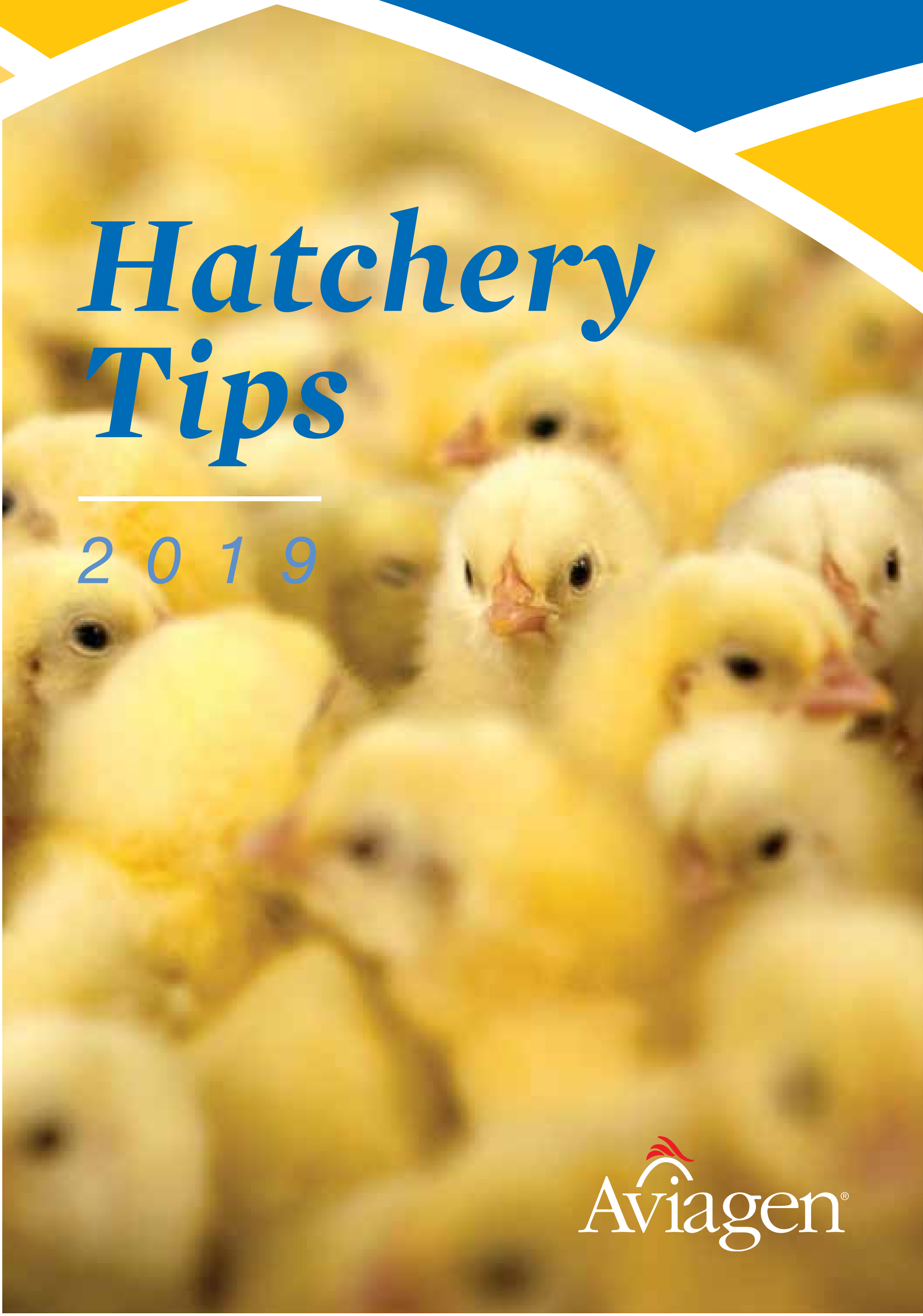
Hatchery Tips

2019



Contents

	Page
Tip 1 - Did You Know That If Chicks Are Held Too Long At High Temperatures, It Can Affect Their Growth?	3
Tip 2 - What Is Your Meconium Score?	4
Tip 3 - Let Your Eggs Guide You	5
Tip 4 - When Did You Last Watch Your Eggs Turning?	6
Tip 5 - Hot Eggs Damage Chick Quality	7
Tip 6 - How Often Do You Check Eggs Coming In To Your Hatchery For Hairline Cracks?	8
Tip 7 - Have You Got A Hatchery Maintenance Plan In Place?	9
Tip 8 - Managing Chick Holding Room Temperatures	10
Tip 9 - Do You Make Regular Checks For Transfer Damage?	11
Tip 10 - Check Hatch Debris Regularly To Identify Egg Turning Problems	12
Tip 11 - Calibrating Electronic Humidity Sensors	13
Tip 12 - Keep Setter Floors Dry	14
Tip 13 - Keeping Chicks Comfortable	15
Tip 14 - Pre-Warming Eggs	16
Tip 15 - Calibrate CO_2 Sensors Regularly	17
Tip 16 - Temperature Calibration Probes	18
Tip 17 - Assessing Alternative Hatching Egg Disinfectants	19
Tip 18 - Correct Positioning Of Hatcher Buggies	20
Tip 19 - Zero Calibration Of Pressure Sensors	21
Tip 20 - Balancing A Set In Single Stage Setters	22
Tip 21 - Check Hatching Egg Quality with UV Light	23
Tip 22 - What is the best temperature for storing eggs?	24
Tip 23 - Egg Yolk Mottling	25
Tip 24 - Mantain the fans in your Setters and Hatchers	26
Tip 25 - Be Careful When you Change to Difffenet Fans in an Incubator	27
Tip 26 - Analyzing Egg Handling with a Thermal Imaging Camera	28
Tip 27 - Are you Measuring and Calculating your Chick Yield Correctly?	29
Tip 28 - If you are Heat Treating Stored Eggs to Improve Hatchability (SPIDES), how Long Should The Eggs be Kept Warm?	30
Tip 29 - Chick Weight Loss Post Pull - What is Normal?	31
Tip 30 - How to Calibrate and Use Temperature Readings taken with Tiny Tag Loggers	32
Tip 31 - Use Water Loss Data to Assess Setter Function	34
Tip 32 - How to Calculate Water Loss Correctly	36
Tip 33 - Checking Fresh Eggs for Unwanted Embryo Development	37
Tip 34 - Hitting the Chick Yield Target	39
Tip 35 - Do we Supply Enough Air to our Incubators?	40
Tip 36 - Chick Box Layout for Laminar Ventilated Chick Holding Rooms	41
Tip 37 - Making the Most of your Hatchery Data. Using Pivot Tables to Boost Hatchery Management	42

Tip 1

Did You Know That If Chicks Are Held Too Long At High Temperatures, It Can Affect Their Growth?

The newly hatched chick can not control its body temperature very well.

Air temperature, humidity, and airspeed interact and will all have an effect on the body temperature and the comfort of the young chick.

It is easy to see if chicks are uncomfortable from their behaviour – chicks that are too hot are noisy and pant (as shown in **Figure 1**) in order to lose heat.

Chicks that are cold will huddle together to keep warm (see **Figure 2**) and their legs will feel cold.

In a recent trial, the Aviagen Hatchery Specialist team showed that chicks that were panting had a high vent temperature (averaging 106°F), while comfortable chicks had a vent temperature that averaged 104°F.

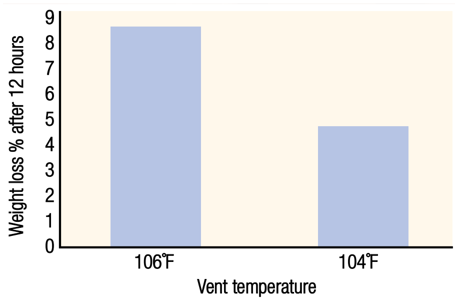
When the two groups were held in the hatchery for 12 hours, the over-heated chicks lost nearly twice as much weight.

Samples taken at the hatchery showed that chicks that had been overheated had slight gut damage, so they could not absorb nutrients as well.

Grown on in a broiler trial, these chicks were 60g lighter at 35 days than chicks that had been held in comfortable conditions.

Figure 1 Chicks that are too hot.

Figure 2 Chicks that are cold.



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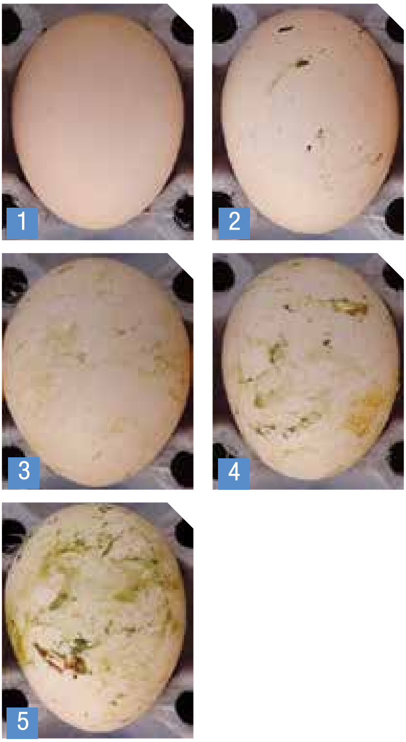
Tip 2

What Is Your Meconium Score?

If chicks are held in the hatcher for too long, they do not grow as well in the broiler house. A good way to tell if this is happening is to check how many of the eggs in a hatcher basket are stained with meconium (the dark green first droppings of the chick).

To find out what your meconium score is, pick out the 5 dirtiest eggs from each of 5 hatcher trays per flock. Select the eggs immediately after the chicks are removed from the hatcher. Score the eggs against the 5-point scale shown below.



If the dirtiest eggs are in groups 4 or 5, then the chicks are being left in the hatcher for too long. Delay the next set by 3 hours and make a note to check again when these eggs hatch in 3 weeks time. When you check them, if there are still eggs in groups 4 or 5 you will need to delay the next set by a further 3 hours.

If all the eggs are clean, check that your total incubation time is not too short – this would be indicated by wet chicks in each hatcher basket and, if very short, live pipped embryos.

If your meconium scores vary from tray to tray, setter temperatures may be variable. Use the meconium scores to adjust setting times so that clean eggs predominate on every tray.

Remember to check every hatch – flock age, egg age, and season can all affect the total incubation time.

Incubation time too long	Incubation time too short
5 or more dirty eggs per tray	Clean egg shells in hatch debris
All chicks dry at time of chick take-off	Some chicks still wet
	Live pipped embryos

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Tip 3

Let Your Eggs Guide You

When you set up your incubator, did you know that your eggs can give you the best guidance on whether the incubator temperature settings are correct?

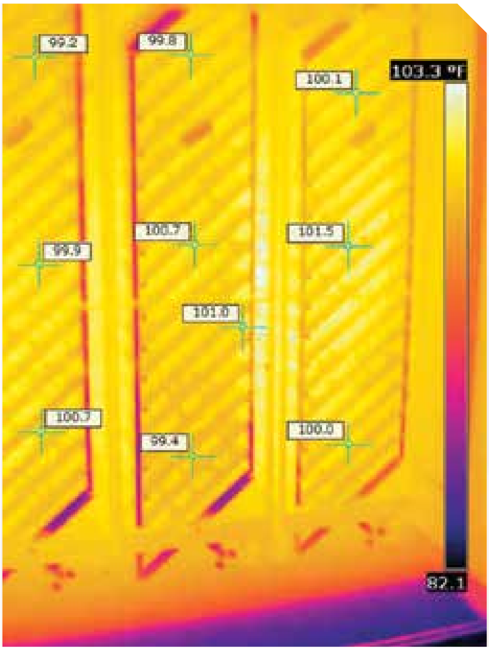
Incubator temperature sensors measure air temperature at various places in the machine. For practical reasons sensors have to be sited somewhere they do not get in the way of loading or cleaning. Because of this, they may not always reflect the air temperature that is experienced by the eggs.

Provided that everything is correctly set up, and the machine is well maintained, then the air temperature is a good indicator that the embryo temperatures are correct as well. But if not, the machine temperature may not predict embryo temperature as accurately as you would like it to.

Once the setter has stabilised, it is wise to calibrate the machine sensors. This should be done using an accurate, certified calibration thermometer, every time the machine is loaded (single stage) or monthly (multi stage). But this only tells you whether the air temperature recorded by the machine sensors is accurate. It may not be at a level which is optimal for the embryos. So, you should also check that your eggs reflect the temperature calibration.

Check the egg shell temperature on day 2 of incubation, when the eggs are up to incubator temperature but the embryo is too small to be producing heat. The eggshell temperatures should all be within ±0.2°F

(0.1°C) of the air temperature in most types of setter. If they are not, it could indicate something is wrong (for example worn door seals, sticking solenoids, etc).



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Tip 4

When Did You Last Watch Your Eggs Turning?

All hatchery managers are busy and it can be difficult to find time to just observe eggs in your setters. But, egg turning is essential for good hatchability and the turning angle, turning frequency, and the smoothness of the turn are of key importance. So, make some time to watch your eggs turning:

- Did the eggs turn when you expected them to?
- Did all the trolleys/trays turn?
- Was the turning smooth and gentle?
- Was the turning angle correct on all the trolleys/ trays?

Incorrect turning angles, or complete turning failure, are among the most frequent issues we identify on hatchery visits. The impact of mildly suboptimal turning angles on hatch can be subtle, but will include increased levels of early and late dead embryos, malpositions in the late deads and also unabsorbed albumen covering some chicks. If you do not correct turning issues as soon as they are found, it will cost you chicks. Turning problems will affect embryo development most severely when they happen early in incubation.

Figure 1 Turning angle of 31.6 degrees is too shallow. Target is 40-45 degrees.

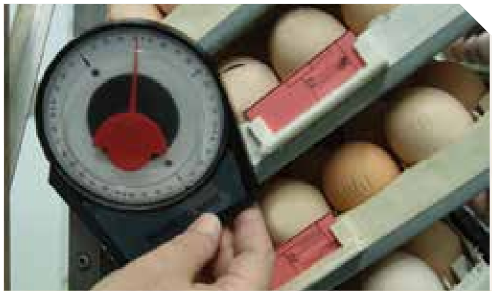

Figure 2 Getting the turning angle just right at 42 degrees.

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Tip 5

Hot Eggs Damage Chick Quality

There is an optimal embryo temperature range where embryos will be comfortable. When eggs get too hot, chick quality will suffer long before hatchability is affected.

Check the eggshell temperatures on days 16 to 18 of incubation, when the embryos are producing a lot of heat, to see if there are any dangerous hot-spots developing in the setters. Use a Braun ThermoScan infra-red ear thermometer, or Tiny Tag temperature loggers to monitor the eggs in the centre of the egg trays in as many different locations as you can.

Chick quality will be affected wherever you find eggshell temperatures exceeding 102°F (38.9°C). Chicks from overheated eggs will hatch earlier, so are more prone to dehydration. They will also be paler, shorter and the yolk sac will be bigger. Unhealed navels will be more common.

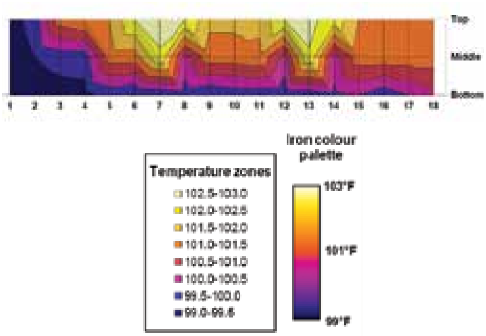
When chick quality is poor, not only will there be more culls and downgrades at the hatchery, but also performance on the broiler farm will be poorer. Chicks from eggs which have been overheated will not grow as well, and will tend to have higher mortality throughout the flock life. Feed conversion may also suffer.

Figure 1 The pale coloured chick was overheated.

Figure 2 Hot area in a single stage setter.

If ventilation is adequate, hatchability is not usually affected until higher eggshell temperatures are reached.

It is easy to visualise the variation in eggshell temperature in the setters by entering the temperatures into an Excel spreadsheet, and plotting a graph using the chart type 'surface' and the option 'contour'. In the example given below, taken from a fixed rack multistage setter and using a thermal image iron colour palette, the graph shows a cool spot near the door and two hot spots in stacks 7 and 13.



Places where eggshell temperatures exceed 102°F (38.9°C) indicate that action is needed. Check door seals, fan speeds, setting patterns (was the set balanced?), spray nozzles, cooling coils, solenoids, water flows, fan blades, turning angles and frequency and incoming air temperature and humidity.

Figure 3 Chicks that are cold.

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Tip 6

How Often Do You Check Eggs Coming In To Your Hatchery For Hairline Cracks?

Identifying all the eggs that have cracked shells on arrival at the hatchery is not easy, but removing and discarding them will increase your hatchability and improve chick quality. As the use of automated egg handling on the farms increases, hairline cracks, in particular, are becoming much more common.

'Hairline' cracks can be difficult to spot. They occur when the force of an impact is just sufficient to crack the crystalline shell, but there is no obvious surface damage or disruption to the underlying shell membranes. Hairline cracks may only become obvious after a few days in the egg store when moisture from the egg contents has had time to penetrate into the crack and produce a faint grey line at the shell surface (**Figure 1**).

A good way to detect hairline cracks is to candle the eggs because the moisture that has entered the crack becomes illuminated brightly (**Figure 2**).

Eggs with hairline cracks can cause just as many problems as eggs with more severe shell damage.

Research has shown that the hatchability of eggs with hairline cracks can be reduced by almost 25%. In addition, there is an increased level of contamination in eggs with hairline cracks which seems to be carried over to the chicks. The mortality of chicks hatched from cracked eggs to two weeks of age was almost four times that in the control group.

When the effect of hairline crack length on hatchability, egg weight loss, embryo losses, chick quality and contamination rates have been studied it is clear that substantial detrimental effects still occur in eggs with only short hairline cracks, such as that in **Figure 3**. So, the message is clear. Cracked eggs and those with hairline cracks are bad news for the hatchery. Not only do they reduce hatchability through increased water loss from the egg, but they are more likely to become contaminated. This contamination is carried over onto the farm by the chicks.

Figure 1

Figure 2

Figure 3

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Tip 7

Have You Got A Hatchery Maintenance Plan In Place?

During hatchery visits we often notice that maintenance is reactive rather than preventative – things are only fixed when they break down.

This can compromise hatchability and chick quality which are the two most important performance factors a hatchery's success is measured on. A scheduled maintenance programme minimises the risk of machine failure and the impact of incorrect machine operation on hatch and quality. A few things to consider when setting up a maintenance programme are:

- Have a dedicated person responsible for maintenance reporting to the hatchery manager.
- Produce a list of all the equipment to be maintained including frequencies.
- Keep records on all performed maintenance.
- Keep track of the spare parts on hand.
- Include the building structure and ancillary equipment in the programme.
- All sensors (temperature, humidity etc) need to be calibrated regularly.

Maintenance is required on any equipment that can affect the performance of the hatchery. This includes setters, hatchers, all chick processing equipment, any measuring equipment (thermometers, hygrometers, pressure gauges), ventilation, generators, all possible water treatment systems, alarm systems and trucks.

All maintenance should be done according to manufacturers' instructions, by using their provided checklists and their recommended maintenance intervals as a minimum. Keeping good records is useful to monitor if the same equipment keeps failing or needs more maintenance than others as this could indicate that there is an underlying problem elsewhere. Keeping track of the spare parts and their usage avoids over ordering unnecessary parts.

Some of the incubation manufacturers now offer technical audits which are extremely helpful to get you started with your maintenance program. Monitoring the equipment allows us to see if the equipment is performing within the acceptable limits and to take action if we notice unacceptable readings.

Regular visual checks should still be done several times a day to ensure temperature, humidity, ventilation and turning are all as they should be. Over time it should be possible to assess costs and benefits of the maintenance programme. Preventive maintenance generally has benefits in all industries and the hatchery is no exception. It contributes to a better hatchability and chick quality, safer work environment, reduced power and utility costs as efficiency is increased, lower insurance costs and retaining a higher value of assets.

Figure 1 Air filters need to be checked and replaced regularly.

Figure 2 Fan belts should be checked regularly and replaced as necessary – this belt is not fit for use.

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Tip 8

Managing Chick Holding Room Temperatures

Newly hatched chicks cannot regulate their body temperature very well. Body temperature in young chicks therefore depends on the surrounding environment. Yet it is crucial to help chicks stay in their thermal comfort zone after they hatch. If chicks are too hot or cold, they will use more energy during holding. If they are too hot, they will also pant and get dehydrated. These chicks will not perform well on the farm.

It is extremely busy on a hatching day in a hatchery and it can be hard to monitor and respond to chick comfort. Sometimes problems with chicks being too hot or cold are only seen when DOA numbers increase. On the other hand, it is not simple to keep chicks within their comfort zone in a chick holding room. There is not one ideal chick holding room temperature, which is suitable in all hatcheries, because it depends on chick size, physical condition, room humidity, chick box type and air speed around the boxes. You need to find the ideal holding room temperatures for different seasons in your own hatchery.

One Aviagen internal study has shown that vent temperature is a good indicator of chick comfort. A chick will be comfortable when its vent temperature is in the range of 103-105°F (39.4-40.6°C). Identify sample chicks and measure chick vent temperature hourly in the chick holding room. If chick vent temperature is too high, lower room temperature settings. If chick vent temperature is low, then increase room temperature settings.

If chicks are sampled and chick vent temperature measured at different locations in the chick holding room you can determine where any hot/cold spots are. Then you can use the information to improve chick trolley design, chick trolley placement in the room, air circulation in the room and room ventilation, so that all chicks will be comfortable throughout the entire chick holding room. Using Excel to map the temperature distribution will help to identify problem areas. In **Figure 2** the chicks were all slightly cold, except in the back right corner, furthest from the door. Raising the room temperature slightly, with some additional cooling fans in the back corner allowed the chicks to maintain a vent temperature above 103°F.

Figure 1 These chicks are too hot.

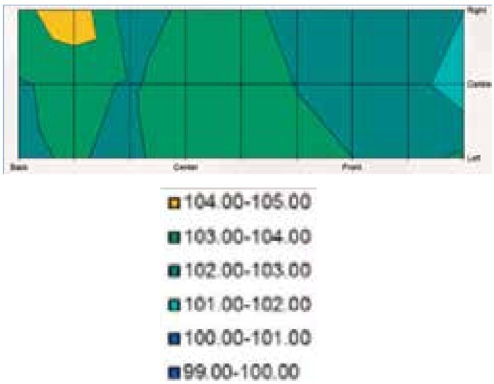

Figure 2 Chick vent temperature by location.

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Tip 9

Do You Make Regular Checks For Transfer Damage?

With the increasing use of automation at transfer, it is tempting to believe that transfer damage is rare. Yet, when we visit hatcheries, we often see significant amounts of transfer damage when doing a breakout.

To make an accurate check for transfer damage, you need to look a bit further than the standard simplified QA check. Ideally, count the number of unhatched eggs per tray in a full stack of hatcher baskets, then look more closely at the eggs in the 3-4 worst trays. Ideally, this should be done so that every transfer crew is monitored at least twice a month; more often if they have new team members.

Transfer damage is caused by rough handling when the eggs are moved from the setter tray to the hatcher basket (cracks from earlier in incubation are easy to see, because in these the egg contents will have completely dried out).Transfer cracks will have some drying out, especially of the shell membranes, but the contents will still be soft (if the egg was infertile, or the embryo died early in incubation the egg contents will generally still be liquid).

The damage shown in the top photograph is usually caused when the tray or buggy has to be pushed hard to get it into position. It tends to be seen on the top trays (after transfer) or on whole buggies if the hatchery floor is damaged. Excessive pressure in the vacuum lifter can damage the blunt end of the egg; in this case the shell does not flake away from the egg. The other common form of external damage is when the handling system has bars or ridges which can cause a linear hole in the side of the egg.

Although it is fairly easy to identify the characteristic external damage caused at transfer, it is possible for the impact to kill the embryo without damaging the shell. When this happens, there are usually blood clots visible, caused by rupture of the external blood vessels.

Figure 1 Impact damage to egg shells during transfer. Impact was to the side of the egg, and the embryos were close to full term and slightly dried out. The shell membranes are white and papery.

Figure 2 Excessive vacuum pressure on the egg lifter has caused damage to the blunt end of the egg.

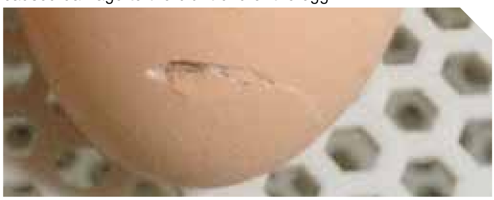

Figure 3 Damage caused by a ridge or bar on the handling equipment.

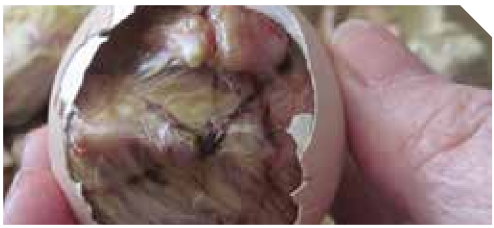

Figure 4 Transfer damage does not always damage the shell; this shows a late dead embryo where rough handling has caused bleeding, and the blood has then clotted.

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Tip 10

Check Hatch Debris Regularly To Identify Egg Turning Problems

Egg turning is a key input for normal embryo development. Brooding hens roll the eggs in their nests; in hatcheries, trays of eggs must be tilted to either side of horizontal. For the best hatchability, eggs should be tilted once an hour to achieve a 38-45° angle to each side. Hatchability will be depressed if turning angles are too shallow, or turning is not frequent enough, especially in the first 7 days.

During the early stages of embryonic growth, the chorio-allantoic membrane (CAM) forms to enclose the albumen. This is the source of the network of blood vessels seen on the inside of the egg shell in hatch debris. If turning is inadequate for any reason, the CAM will not form properly, and short-circuits the small end of the egg, leaving a circular patch with no covering of blood vessels.

Failure of egg turning or inadequate egg turning (frequency or angle) will cause raised levels of early dead (membrane and blood ring) and late dead embryos. The late deads will show characteristic signs of turning failure due to poor growth of the CAM, leaving residual albumen in the bottom of the egg. There will also be more undersized embryos, and the incidence of two specific malpositions, malposition-II (head in small end of the egg) and malposition-III (head to left) will be raised. This specific combination of embryo mortality categories is a typical indicator of egg turning issues in the hatchery.

Turning problems are one of the more common issues seen by Aviagen hatchery specialists when visiting commercial hatcheries. There are two main reasons for this. In older hatcheries, multi-stage incubators are getting older. Their turning systems have become worn. Occasionally they fail completely, or more often do not manage to achieve adequate turning angles. In newer hatcheries, with single-stage incubators, it can be tricky to spot problems because the focus is on keeping the machines sealed for the first few days and this can make people very reluctant to open the setter doors to check the turning. The very big modern setters put a big load on the turning mechanism and this can cause turning angles to drop below the optimum.

Unfortunately, the critical sealed period is also the most critical period for egg turning.

In order to identify and resolve egg turning issues, especially mild chronic ones, a routine hatch debris breakout program should be implemented in every hatchery. A rise in both early and late deads with poor CAM growth, malposition II or III or residual albumen on the hatched chick is a strong indication of a turning issue. Check the turning angle in both directions, and make sure that eggs are turned once an hour with regular inspection, opening the setter door to do so.

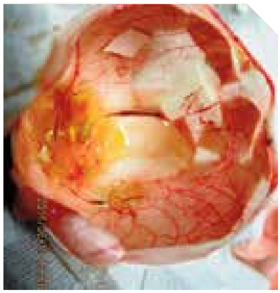

Figure 1 The CAM did not reach the pointed end of the egg, leaving some albumen unavailable to the developing embryo.

Figure 2 A chick with residual albumen on the down.

First published in International Hatchery Practice

Tip 11

Calibrating Electronic Humidity Sensors

Calibrating the humidity sensors in incubators can be tricky. However, if the machine has electronic humidity sensors a saturated solution of a specific chemical compound, presented to the sensor in a sealed container, will give an accurate and predictable reading which can be used to calibrate the machine. Saturated solutions of different salts will, depending on the temperature, always give the same reading on an electronic humidity sensor. Two of these compounds are suitable for use to calibrate setter or hatcher electronic humidity sensors at incubation/hatcher temperatures (98-100°F).

Magnesium nitrate hexahydrate [Mg(NO3)2.6H2O] will read 50% and sodium chloride [NaCl] will read 75% RH. If the machine shows a wet bulb temperature, rather than a percentage RH, then the predicted reading will alter slightly depending on the air (dry bulb) temperature in force at the time of calibration. The table below shows what to expect at different dry bulb temperatures for both chemicals. Correct preparation of the solution is very important. Too much or insufficient water addition will give inaccurate results. Salts should be of consistent purity, ideally laboratory grade.

Steps:

1. Fill the sensor protection bottle quarter full with the dry salt. Prepare a syringe full of water.
2. Add a small amount of water to the salt and shake well.
3. When the salt becomes sticky (it will stick to the bottle) the solution is ready to use. Turn off the humidity alarm of the machine.
4. Screw the bottle to the fitting above the humidity sensor. The humidity reading will stabilise once the salt solution has reached incubation temperature (about an hour).
5. Once the humidity becomes stable, calibrate your sensor to the expected value for the machine temperature at the time (see Table).
6. Remove the bottle to finish calibration, turn on the alarm and run the machine normally. Humidity will shortly start showing actual level. One batch of solution can be used for five machines.

It is good practice to repeat this calibration every set for single stage machines and every month for multi-stage machines.

1

2

3

4

Dry bulb temperature (actual machine temperature)	Approximate wet bulb temperature (°F)	
	Sodium Chloride	Magnesium Nitrate Hexahydrate
100	92.5	83.5
99.5	92.0	83.0
98.5	91.0	82.2
98.0	90.5	81.8

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Tip 12
Keep Setter Floors Dry

Wet setter floors are often seen in hatcheries. Staff do not usually pay much attention, and often think they are unavoidable.

Wet floors can have several negative effects on incubation conditions and chick quality. Firstly, water will evaporate off the open water surface, causing localised cooling of the surface. The rising water vapour will then hit the eggs placed on the lower egg trays. This has a cooling effect on these eggs slowing down their embryo development compared to eggs in other positions in the setter. In addition, with machine temperatures around 100ºF (37.8ºC) the wet warmth provides an ideal environment for promoting the growth of mould and bacteria – especially on wet surfaces. The water vapour can also carry bacteria and mould spores which can settle on the egg shell or penetrate through micro fissures in the shell into the egg. In other words eggs on the bottom of a machine with a wet floor will be cooler and in danger of becoming contaminated.

With some single stage setters, especially if they are sealed for most of the first half of incubation, it is very difficult to avoid wet floors and walls. The eggs release moisture through the egg shell, and in a well sealed incubator humidity builds up to very high levels. At these very high humidity levels and at incubation temperature, condensation on the walls and pipework is almost unavoidable, and the water soon drips down to the floor. The best way to prevent the humidity building to such a high level is to open the dampers slightly once the setter is up to temperature, leaving it very slightly open for the first 24 hours of incubation.

Once the dampers are closed, the humidity will build again, so it is usually best to start ventilating the setter after day seven of incubation at the latest.

Once single stage setters are being ventilated, or in a hatchery which uses multi stage setters, then the floors should always be dry. If water is seen on the floors, then action needs to be taken to stop it.

Wet floors in incubators can be caused by:

- Leaking connections to the cooling pipes, the humidity spray nozzles or solenoids.
- Pinholes in the copper cooling pipes.
- Condensation from the cooling pipes or solenoids – especially if the water chiller is set colder than necessary.
- Catching troughs or gutters not in place, blocked or leaking.
- Spray nozzles not functioning properly.

Most of the above causes have to do with maintenance and can be avoided by having an effective preventative maintenance plan in place.

Figure 1 Standing water on the floor of a single stage setter at the end of the sealed period.

First published in International Hatchery Practice

Tip 13

Keeping Chicks Comfortable

Newly hatched chicks can not regulate their body temperature and rely on suitable environmental conditions to keep them comfortable. In an ideal production system, chicks would be moved from hatcher to farm promptly and quickly. In real production systems there can be several hours between take off and when the chicks are placed on the farm.

The best first week mortality and post-hatch performance will be seen from chicks kept in good conditions between leaving the hatcher and placement on the farm. Suitable room conditions are:

- Room air temperature 22-28°C (depending on air speed around the boxes).
- Relative humidity 50-65%.
- 85m3 fresh air per hour per 1000chicks – the CO_2 level in the room should not go over 2000ppm.

Figure 1 High CO_2 level measured in a holding room with insufficient ventilation.

The chicks will be calmer if the chick holding room has dim blue light. Temperature, humidity and air speed all interact to determine the temperature around the chicks. A good ventilation system will remove hot, humid air from around the boxes, without creating a draft directly on to the chicks. Air temperature at chick level inside the box should be around 30-32°C (86-89.6°F), 60-70% RH.

Chicks use behaviour to help control their body temperature, so monitor chick behaviour to know if they are comfortable or not. Chick vent temperature is easy to measure, and highly correlated with deep body temperature. The optimum chick vent temperature is 39.4-40.5°C (103-105°F).

- Chicks that are too cold, vent temperature below 39.4°C (103°F), start to huddle and have cold legs and feet.
- Chicks at correct temperature are quiet and evenly spread out.
- Chicks that are too hot, above 40.5°C (105°F), start panting.

Chick vent temperature measurements can be used to check chick comfort in hatchers, chick rooms, in chick trucks and during the first two days of brooding. Chicks should be sampled throughout the area where they are being held and from near the top, middle and bottom of chick box stacks. Pay particular attention to areas:

- Where chicks are observed to be panting or huddling.
- Where there is fast air movement around the chick boxes.
- Near walls and doors.

Figure 2 A good layout for a chick holding room with well spaced buggies.

First published in International Hatchery Practice

Tip 14

Pre-Warming Eggs

Single-stage setters are very popular nowadays, but there are still a lot of multi-stage setters in use. In normal circumstances, multi-stage setters are very stable, with a lot of the heat needed coming from the older embryos. For this reason, they are not usually equipped with as much heating or cooling capacity as is needed by single-stage setters. In some circumstances, this lack of heating capacity can be a disadvantage. Hatch and chick quality can be badly affected if eggs are not pre-warmed before they are set.

Figure 1 below shows shell temperatures of eggs at around five days incubation, immediately after a new batch of eggs had been added to a multi-stage setter. The red line shows temperature changes when the new eggs were set directly from the egg store (59°F, 15°C). The blue line shows the much less severe impact when the new eggs had been pre-warmed before they were set. When eggs were set cold, then egg shell temperature dropped by 9.0°F (5.1°C), and took four hours to return to optimum incubation temperature.

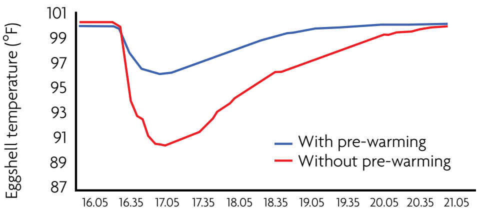
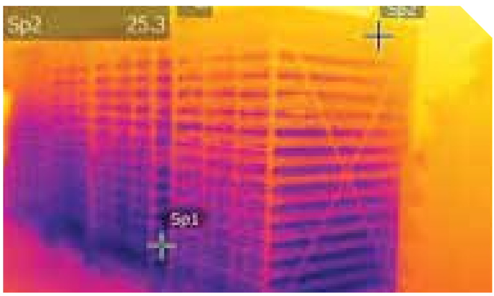


Figure 1 Eggshell temperature changes in part-incubated eggs immediately after more eggs are set either from the cold store or after pre-warming.

Periods where eggshell temperatures are low (< 99.0°F, 37.2°C) will delay the hatch and can also increase levels of early embryo mortality and damage chick quality. A further issue when eggs are set cold into a warm, humid incubator is that they may 'sweat'. This surface condensation will increase the likelihood of bacteria getting into the egg and causing rots and bangers.

To minimise temperature shock and sweating, eggs should be pre warmed to the setter room temperature (75-79°F, 23.9-26.1°C) before setting.

- Move eggs from the egg store to the setter room 6-8 hours before setting. Leave 20cm gaps between trolleys and away from walls, so that air can circulate easily.
- Run ceiling fans to create air circulation though the eggs (avoid blowing air directly onto them). The thermal image, below, shows uneven eggshell temperatures in trolleys after pre-warming without forced air circulation.



First published in International Hatchery Practice

Tip 15

Calibrate CO_2 Sensors Regularly

Most modern single-stage setters and hatchers are fitted with carbon dioxide (CO_2) sensors, automating adjustment of the machine dampers according to the CO_2 accumulated from the developing embryos. This can work well, but only if the CO_2 sensors are accurate. Sensors which under or over record will result in the machine being incorrectly ventilated. When this happens, it can lead to gradually declining chick quality and hatchability.

The first step is to make sure that the CO_2 sensors are all reading correctly. Prolonged exposure to high humidity levels during sealed incubation, and to chick fluff and humidity during hatching or even washing water can all affect the sensor or sensor protection cap leading to inaccurate readings. The sensors must be calibrated regularly.

Ideally, the sensors should be calibrated at low, mid and high CO_2 levels, proving that they are reading correctly across the desired range. A simple calibration can be done using an electronic meter (which is itself regularly calibrated against known standards) to check that both machine and calibration sensor are giving the same reading at room CO_2 levels. This will usually be higher than the 400ppm (0.04%) normal for fresh air; both people and chick embryos will be producing CO_2 in the building which will drive the concentration up. However, mid- and high-end values can be checked during incubation only if your calibration instrument sensor can be inserted into the incubator next to the machine probe without opening doors or air vents.

Alternatively, higher CO_2 levels can be calibrated using a CO_2 gas mixture with a known, certified CO_2 concentration while the machine is empty. These are used to fill a cap or bottle sealed around the sensor unit. Mixtures with certified CO_2 concentrations of 5,000 and 8,000ppm (0.5 and 0.8%) are readily available on the market.

Having calibrated the sensors, you must then make sure that the machine is still able to support higher levels of CO_2. Levels can only rise if the incubator is well sealed against air leakage. Check that the seals around doors and dampers are not worn, and make sure that both can be closed tightly. The calibration on damper opening should also be checked. An easy way to check that the machine can be properly sealed is to stand inside the empty, powered down incubator with the doors and dampers closed. If you can see any light, the machine will not seal properly.

High CO_2 levels will not of themselves improve hatchability or chick quality. However, measuring CO_2 build up can be a useful tool to show when a machine needs fresh air. For this to work consistently the sensors need to be calibrated accurately and the rate that CO_2 accumulates in the machine must be predictable. If either of these fail, then ventilation rates will be incorrect.

Figure 1 The photograph above shows typical CO_2 sensors in a setter, protected by sensor protection caps. If the caps become clogged with dust or condensation, the sensor will give an artificially high reading.

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Tip 16

Temperature Calibration Probes

It is important to check and calibrate the temperature sensors in setters and hatchers regularly, using a calibration probe which is accurate to 0.2°F, and readable to 0.1°F. With regular calibration we start to see benefits in consistency and predictability between machines, because their temperatures are exactly the same.

Today, with advancing technology, we have a great opportunity to use new, more accurate tools to calibrate setters and hatchers. It is possible now to buy reliable and accurate calibration thermometers (accuracy of ±0.2°F) at an affordable price. However, it can be a challenge to get the calibration probe into the right place to check the machine sensor. In principle, the best place to put the calibration probe is right beside the machine probe. Unfortunately, this may not be possible if the probe does not have a long lead to reach into the machine. For this reason, probes are often inserted through a specially drilled hole to just inside the machine door, without first checking how closely the temperature there corresponds to the temperature next to the machine sensor. To achieve a proper calibration, the calibration probe has to be placed at a location which is consistently within 0.2°F points of the air temperature at the machine probe. Without doubt, a position next to the machine probe will give the best accuracy. Unfortunately, some calibration devices have very short cables and simply will not reach to the machine probe from outside the setter door. In situations like this, if it is not possible to find a close location, the only way to achieve a satisfactory calibration reading is to look for a reachable position which runs at a similar temperature to that around the machine sensor(s).

When looking for such a position, the machine should be fully loaded and turned to the calibration position following manufacturer's suggestion. Machine doors and seals should be checked and maintained as necessary to avoid false readings due to air leakage. For single-stage machines, check between days 2 and 3. For multistage machines, check at least 24 hours after the last set. First, the machine probe should be calibrated properly. For this purpose it is worth the extra trouble to place the calibration probe right next to the machine probe, however difficult this may be. After completing an accurate calibration at the sensor, place the calibration probe in different positions to find a spot which runs at the same temperature as next to the sensor. Each time the probe is moved, allow the machine to run normally for at least one hour before reading the temperature. When the machine probe and calibration probe readings are similar (less than ±0.2°F difference), drill a hole in the wall or roof to allow the calibration sensor to be inserted at that point. Once you have found the best position in one machine, the same location can be used for all the other machines of that type and capacity.

Figure 1 A hole drilled in the door and protected with a metal plate allows the insertion of the calibration probe close to the temperature sensor.

First published in International Hatchery Practice

Tip 17

Assessing Alternative Hatching Egg Disinfectants

Hatching eggs need to have the shell surface disinfected at some point between the farm and the hatchery. This is good practice and often a legal requirement. Traditionally this was done using formaldehyde gas, but there are increasingly stringent regulations making its use on farms and in the hatchery more difficult.

Formaldehyde is a difficult disinfectant to replace. It is very effective against a wide range of micro-organisms; it forms a dry gas so does not wet the egg surface; and it is harmless to the paused embryo in the fertile hatching egg. It is also cheap. However, a variety of alternative disinfectants are being suggested.

Any alternative product needs to give a satisfactory kill rate of the micro-organisms on the shell surface, ideally without wetting the egg shell. It needs to be gentle enough not to damage the cuticle covering the egg shell – with no cuticle left the eggs are more open to internal contamination after treatment – and it needs to be safe for the embryo inside the egg.

When offered an alternative hatching egg treatment, always ask questions. What is the active ingredient? How is the treatment delivered? Does it need to be dissolved in water? What percentage of the micro-organisms on the egg shell will it kill? Most suppliers will be able to answer all these questions, but may have more trouble with the most important one. “This product kills bacteria on the egg shell – can you prove to me that it won’t kill the embryo inside the egg shell?”

To be confident that the chemical, or the method of application, will support good hatchability, you need to see trial results (or run your own). When you start to think about existing differences between flocks, between egg collections through the day, egg storage conditions and even individual incubators, it is obvious that the trials will need to be carefully designed, will need to take account of a lot of variables and should use a lot of eggs. As a starting point, trials should include eggs from young, prime and old flocks – old flocks are probably the most vulnerable to mistreatment of any kind. Trials should be repeated, and they should be designed to equalise the hatch potential of the eggs going into each treatment. Always have a control treatment, where eggs are given your current standard treatment. To set up this sort of trial you could:

- Put alternate setter trays from every collection into treatments A or B as they are packed.
- Or compare eggs packed Monday, Wednesday and Friday with those packed Tuesday, Thursday and Saturday.
- Or even compare whole houses, but switch the treatments at intervals so each house is its own control.

Aim to use at least 2,000 eggs per treatment per run, and to repeat each comparison at least 10 times over a range of flock ages.

Without this sort of careful comparison, you will never really know whether the treatment is giving you results that you expect, has made things worse or (very rarely) given better hatch or chick quality.

Figure 1 A fumigation cabinet.

First published in International Hatchery Practice

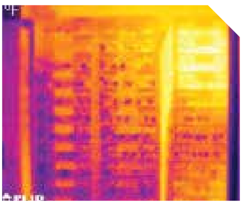
Tip 18

Correct Positioning Of Hatcher Buggies

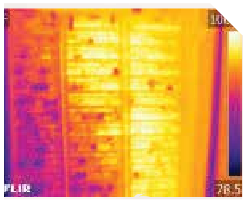
The ventilation capacity of modern hatchers is calculated by the manufacturers to ensure that enough fresh air is introduced and waste air removed. The fans inside the hatchers are designed to provide an even airflow over all the eggs or chicks in the hatcher baskets. When everything is correctly set up, they prevent hot spots or CO_2 build up around the chicks. Overheating or excessively high CO_2 levels in the hatcher will cause poor broiler performance or in extreme cases reduced hatchability and higher culling rates.

Moving air will always look for the path of least resistance and therefore when pushed around inside the machine it will take the easiest route back to the fans. Positioning the hatcher buggies the correct way, following the manufacturers' recommendations is therefore essential to providing the needed airflow over the eggs or chicks.

There are various different fan arrangements in different makes of hatcher. Hatchers with a centrally mounted fan will throw the fresh air around the baskets and draw the air back in towards the centre of the fan. A different design has the fans mounted to push air upwards, with air then drawn down through the hatcher baskets back to the negative pressure area below the fans. Both systems work well. However, in either scenario if the hatcher buggies are not positioned correctly leaving too much gap between them some of the air will use that gap as an easy path of return to the fans, depriving some of the hatcher baskets of the air they need.



One of the common problems we see in hatcheries is when the baskets are not stacked correctly at transfer, allowing the stack to lean away from the vertical. The pair of pictures above clearly show the consequences when the outer buggy, leaning away from the vertical, is creating a larger air gap at the top and, as such, is lacking the necessary airflow through the trays. The thermal image shows how this creates a hot spot in the upper right hand corner of the hatcher.



Some older designs of hatcher have baffles installed toward the front of the sidewalls (see above). In these machines it is crucial that the baffles are kept in good repair, and that the outer buggies are touching these baffles in order to force the air through the hatcher baskets back to the fans.

We talk a lot about controlling embryo temperature in the setters, and how overheating between days 11 and 18 affects not only hatchability and chick quality, but also broiler growth and liveability. New research is showing that keeping tight control of eggshell temperature in the hatcher right up to the point of external pipping is critical if the best performance in the hatchery and the broiler farm are to be targetted.

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Tip 19

Zero Calibration Of Pressure Sensors

Incubators will usually only work properly if there is an air pressure gradient between the air inlet and the exhaust. This means that the rooms and plenums supplying and exhausting air need to operate at the correct pressure differential. The incubator supplier will provide the specifications needed for their machines, and hatchery ventilation systems must then be designed to deliver the required room static pressures. Once in service, air spaces will need to be monitored with suitable pressure sensors, so that the air pressure can be corrected as necessary on a continuous basis (right).

There are two ways to calibrate pressure sensors. The first one is to do a full range calibration (Span) which includes the zero and extremes of the range covered by the sensor. This method needs some special equipment and procedures and is therefore not always possible to apply under hatchery conditions. The second method is to apply only a zero calibration. By this method, the sensor can be calibrated at neutral pressure to zero.

There are many kinds of pressure sensors and most of them have a special button, jumper, screw or menu to allow zero calibration (examples shown right). To perform a zero calibration, first remove all the tubes entering the sensor, leaving the hose connectors vented into the same air space. By doing this, the difference between low pressure and high pressure tubes will be zero. Depending on the make of sensor, and following the manufacturer's directions either:

- Press and hold the 'zero' switch for about 4-5 seconds.
- Or set the jumper for zero calibration option and hold for 4-5 seconds.
- Or turn the screw until the display shows zero.
- Or if the sensor has a setup menu, follow the menu instructions to make the reading zero.

The zero point should now be set and, if a display is present, the display will read zero. A zero calibration should be performed at least once a month. The hatchery environment is potentially a very challenging one, with the possibility of water, chemicals and fluff particles around the sensor. This can affect sensor accuracy. Some sensors have an automated zero calibration option, but it is still wise to check the sensors regularly to see if they are working correctly. Accurate control of static pressure in the hatchery is critical if the incubators are to work properly. Regular zero calibration of the pressure sensors will help to make this possible.

Figure 1 Zero switch.

Figure 2 Menu driven zero calibration.

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Tip 20

Balancing A Set In Single Stage Setters

Although the optimal eggshell temperature for maximum hatch and chick quality is in the range 37.8-38.3°C (or 100-101°F), it is not always easy to keep within this range in a commercial setter. One of the most common causes of uneven temperatures is when the eggs are loaded into the setter without allowing for differences in their potential heat output or when gaps in the set allow air to short circuit the optimal path.

Nowadays, more and more hatcheries install enormous setters, to save space and cost. Depending on the make, there will be one air temperature sensor in each setter or in each sub-section of it. In principle, the sensor controls heating and cooling to keep the air temperature within the machine set-points and keep eggshell temperature within the optimal range. For this to work properly embryo heat production needs to be spread evenly throughout the setter and all the eggs affected by a temperature sensor should be of similar size and fertility. Unfortunately in the real world parent flock sizes are often variable and never match the setter capacities available. A large setter will have to be filled using eggs from more than one parent flocks, or sometimes run partially full. If not managed carefully, it is very easy to create an unbalanced loading pattern.

The heat output of a batch of eggs will depend on several factors. It is important to take these into account when deciding where to put each batch of eggs in a large setter.

- Egg size. Large eggs produce large embryos, which produce more total heat per egg.
- Flock age. Eggs from flocks under 30 weeks tend to produce less heat per egg than would be expected for their size.
- Fertility. There are more eggs with live embryos when fertility is higher. If a flock is more fertile, heat production per 1,000 eggs will be higher.

Unbalanced egg loading in the setter may exaggerate variability in eggshell temperature (especially after 12 days of incubation) and consequently widen the hatch window and cause poor chick quality.

Embryo (eggshell) temperature will be cooler where eggs have a lower heat production and these chicks will hatch later and some of them may be culled because they are still wet and lethargic at take-off.

Embryo temperature will be hotter where eggs have a higher heat production causing chicks to hatch earlier, with some of them getting dehydrated before pulling. If eggshell temperature goes to a very high level, 103°F or above, hatchability and chick quality will be depressed.

Here are some tips to balance egg loading in the setter:

- As a good start, follow the recommendations from the incubator manufacturers.
- When you have to mix egg sources in a setter, always choose the ones from similar flock ages and with similar fertility.
- Put eggs closest to average next to the temperature sensors.
- When you can not completely fill a setter, always set the eggs in a pattern which will not change the normal air flow or cause short-cuts of air flow in the setter. Fill any gaps with empty trays or trollies.
- Always check eggshell temperature and its evenness if you try a new egg loading pattern.

First published in International Hatchery Practice

Tip 21

Check Hatching Egg Quality with UV Light

Hatching egg quality has a significant impact on hatchability and chick quality. Not every problem with the egg shell can be seen with the naked eye, but a device in your pocket can help you go beyond that biological limit. A UV flash light can be an invaluable tool to help identify egg shell hygiene issues.

Many hatcheries receive only a limited history of the eggs delivered from the farms. However, wiped, washed, scraped or otherwise cleaned eggs can cause serious contamination issues in a hatchery. Even when eggs are put through selection and grading on arrival, some problematic eggs can still go undetected on a simple visual assessment. If we can find these eggs, segregating and setting them in a separate incubator or at least setting them in the bottom trays, can help a lot to avoid contamination.

A UV flashlight can be used to identify:

- Washed eggs
- Sprayed eggs
- Wiped eggs
- Scraped/physically cleaned eggs
- Dirty/floor eggs

Using a UV light is very easy. A pocket size UV torch with 395nm wavelength is sufficient to identify the main issues. You do need a dark environment when doing an investigation. Direct the UV light source on the eggs and try to find shiny and different looking eggs. Some examples of problem eggs are shown below, with the cause identified:

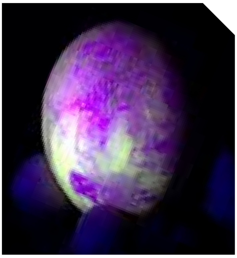

Figure 1 Floor egg.

Figure 2 Dirty egg.

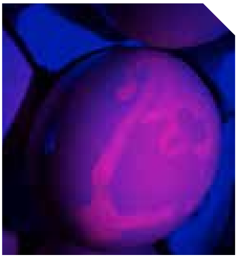

Figure 3 Poor spray sanitation.

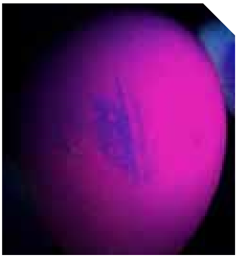

Figure 4 Scraping.

Avoid looking into the UV light directly; this can cause serious eye damage. Just like any other type of UV lights, LED UV light sources have a finite life span. Change the torch when it becomes difficult to see the colour differences.

If a monitoring system is set up to do regular random checks for all flocks, the information generated can provide a timely feedback or warning to increase the focus on egg selection on farm.

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Aviagen

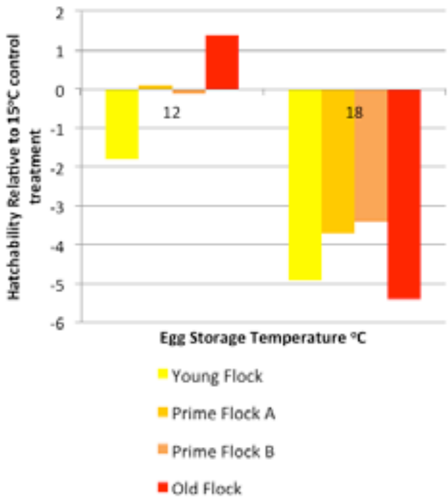
Tip 22

What is the best temperature for storing eggs?

Most hatchery planners aim to keep egg age under 7 days at set. However, even in broiler hatcheries this is not always easy, or even possible. You may need to build up numbers so that a single broiler unit can be filled using eggs from only one breeder flock, order sizes may not be exactly even day to day or there may be a general slowdown in the market for seasonal or other reasons. Most advice on egg storage conditions suggests that the temperature should be adjusted dynamically depending on the average egg age. However, in practice the advice is seen as too complicated and is rarely followed. Consequently, in many operations egg storage temperature stays firmly at 17-18°C, no matter what the egg age. In fact, the best advice is that egg store temperature should always be adjusted downwards to be optimal for the oldest eggs. Fresh eggs hatch just as well stored at colder temperatures, but older eggs suffer badly if the egg store is held too warm. The only thing you need to watch out for is the possibility of condensation when moving eggs from the cold egg store into the setter rooms.

Keeping eggs which need to be stored for longer at a lower temperature slows down the physical deterioration to the albumen and yolk membranes which are needed to support the best hatchability. The embryo will also be affected by both storage time and storage temperature, and colder storage slows down the rate of deterioration in the embryo as well. A recent collaborative study between Aviagen and Ankara University investigated the effect of storage temperature on hatchability in eggs stored for 14 days, as part of a larger investigation into how SPIDES treatments interacted with storage temperatures. In the study, covering young, prime and old grandparent flocks, hatchability was much better when 14-day-old eggs were stored at 15°C rather than 18°C. More unexpectedly, eggs stored at 12°C hatched no better than those stored at 15°C. The hatchery where the trials were done is unusual in having three separately controlled egg stores, so it was possible to run comparisons of the three storage temperatures simultaneously which gave a very robust comparison of the three storage temperatures. The trial was repeated over four batches of eggs, from young, prime and old flocks.

The graph below shows how eggs stored at 18°C hatched worse than those stored at 15°C by an average of 4.4% over 4 comparisons covering young, prime and older flock ages. In contrast, when hatch of eggs stored at 12°C was compared with hatch of eggs stored at 15°C, there was no overall improvement.



Our conclusion from these trials was that unless eggs are only being set when very fresh (no more than 4 days old) it is probably better to run egg stores at 15°C rather than 18°C. When setting eggs within the hatchery condensation is unlikely to be a problem following storage at 15°C, but if you are worried check the dew point table in Investigating Hatchery Practice to make sure.

First published in International Hatchery Practice

Tip 23

Egg Yolk Mottling

Levels of mottling in egg yolks seem to be quite high at the moment. Mottling is something that is often identified when there are reports of high levels of very early dead embryos, or particularly poor hatch after egg storage longer than 4-5 days. Opening candled clear eggs shows that there is very little embryo development. But unlike infertile eggs, often the yolk membrane has broken and the yolk is mingled with the albumen.

Examining fresh eggs usually shows that fertility is normal for the flock age, but that the yolk surface looks different – there are areas of the yolk that look translucent in mild cases (picture 1) but a tan color in more severe ones (picture 2). This is due to changes in the membrane around the yolk which allow water to collect between the layers. This makes the yolk more fragile, and less able to support normal embryo development.

It is normal to see some mottling, which will get worse as eggs age. It will not necessarily be easy to see in fresh eggs on the breeder farm. However, if the incidence of candled clear eggs is higher than expected and fertility is normal, it is worth checking eggs carefully for mottling.

Mottling can be caused by a variety of factors affecting the breeder hens. One of the best known is contamination of the feed with Nicarbazine (or an anticoccidial containing Nicarbazine). Wormers such as Piperazine can cause mottling, as can gossypol from cottonseed meal (above 0.005%) or tannins from sorghum (above 1%). Yolk mottling also tends to be high in years where fungal diseases in wheat and maize cause a high or erratic mycotoxin burden in finished feed.

Management factors which put the birds under stress can also cause them to lay eggs with mottled yolks. Over mating is a surprisingly common cause – which tends to escalate if the candled clears are perceived to be due to poor fertility, triggering early or over generous spiking. The bird handling necessary for taking blood or swab samples can also cause a rise in mottling.

Sometimes the cause of mottling is not immediately obvious. In this case, a review of the feed formulation and raw materials in the feed mill will be helpful, along with a review of the birds' behavior. This should include periods of observation in the house, watching the birds feeding, selecting nests to lay in and during peak mating times.

Figure 1

Figure 2

First published in International Hatchery Practice

Tip 24

Mantain the fans in your Setters and Hatchers

Incubators sold by the various manufacturers have a range of fan designs. However, the fans all have the same function, which is to move fresh air into the cabinet, and to provide an airflow pattern within the filled cabinet which is balanced and of sufficient airspeed over all of the eggs or chicks to keep them at their optimal temperature.

Regular and effective maintenance is crucial if the fans are to deliver the right amount of air in the right places and at the right speed. There are several aspects of fan set up, wear and (lack of) maintenance which will cause the fans to need attention.

Fan blade damage – if the fans are bent or dented, they will not deliver optimal airflow. Damaged blades should be replaced as soon as possible.

Fan positioning is important, and problems can be seen after a fan has been replaced if it is not positioned correctly. This is especially important when the fan needs to be mounted in a fan housing. The fan must be mounted at the correct height within the housing, so that the air can only move in the desired direction. If the fan is mounted slightly above the housing, air will tend to escape to the sides. The fan must always be mounted centrally within the housing – if it is offset then a 'blow-by' effect can be caused, where some air is sucked back away from the desired airflow. Make sure that the fan is pushing the air in the correct direction.

Figure 1 Clean fan blades, well centred fan and correct height.

Fan speeds need to be checked regularly using a suitable tachometer. Regular maintenance should be set up to check:-

a. Belt tension – too loose and the rubber belt will slip on the metal pulley - listen for a squeal on start up. This can cause the fan to slow down. If the belt is too tight it will grind into the pulley and wear out more quickly.

b. Pulley size, condition and alignment – a worn pulley should be replaced using one of the same size. Once in place, the fan belt should sit in the pulley groove, with its top surface level with the edge. If the belt sits proud or inset, either it is worn, or the wrong belt is being used. Make sure that the pulleys are in a straight line.

c. Belt worn out – fan belts tend to become brittle, glazed or cracked. Belts are relatively cheap, so replace them regularly as part of a preventative maintenance programme.

d. The rating of the fan motor – when replacing a failed or failing motor, make sure that it has the correct specification to be an exact replacement. Check that the voltage supplied to the new fan is correct.

Fan cleanliness – especially in multistage machines and hatchers dust, dirt and chick fluff can settle on and stick to the fan blade edges, making them less efficient. This should be cleaned off regularly. If the water used for humidification has a high mineral content, a hard residue can form on the fan blades, again making them less efficient. The residue should be removed carefully, making sure that the blade is not deformed in the process.

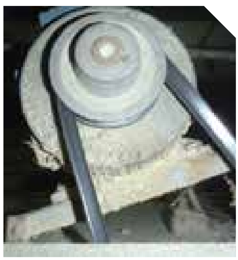


Figure 2 Incorrect fan belt sitting low in the pulley.

Figure 3 Worn fan belt.

First published in International Hatchery Practice

Tip 25

Be Careful When you Change to Difffenet Fans in an Incubator

One fundamental factor for hatching good quality chicks is having the correct eggshell temperature (EST) throughout incubation. The incubator is set up to control air temperature, which is not the same as EST. Two factors make the two temperatures diverge –the heat production of the embryos as they grow and develop, and the ability of the air moving through the machine to take up and remove surplus heat. Embryo heat production increases rapidly after 10 days of incubation and then plateaus briefly at 17-18 days of incubation at around 138mW/egg. Air movement within the setter plays an important role in removing surplus heat from around the eggs, its effectiveness driven mostly by air speed between the setter trays.

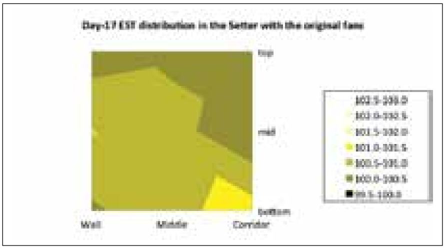
In reality, air speed varies within the setter. Eggs located in a position with low air speed, will have higher eggshell temperature in the last week of incubation than eggs located where air speed is higher. It can be a big challenge to achieve even air speed (and hence eggshell temperature) in the setters in many hatcheries.

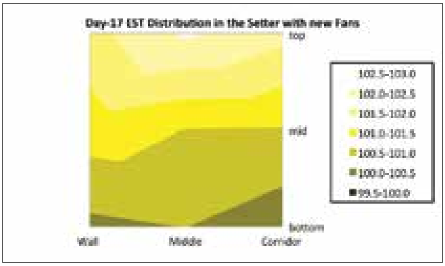
A possible way to get more uniform air speed in the setter could be by replacing existing fans with stronger ones or simply by speeding up the existing fans. Average air speed in the setter will be increased by either modification. But in making the change to the fan speed, air speed within the incubator may become even less uniform.

In a European hatchery with fixed-rack multi-stage incubators, the manager was not satisfied with eggshell temperature and its uniformity. She thought that the original propeller fans were not strong enough to deliver the air all the way down to the floor. In trial machines, the fans were replaced with stronger axial fans. To everyone's surprise, they saw no improvements in chick quality and hatchability.

In fact, the stronger fans made things worse: the machine became too cold at floor level and too hot higher up. During the experiment, air speed in the two trial setters was measured with a hot-wire anemometer and eggshell temperature was measured with Tiny Tag temperature loggers.

The new fans increased air speed by an average of 0.5m/s. However, the average EST increased, with the hottest area moving from the bottom of the machine to the top.





The EST area plots show that despite the higher air speed, the average EST was higher, with more eggs falling into the band above 102F which is where problems of quality may be expected to start.

In a setter, air doesn't always take the route we expect. Setting pattern, egg size and even turning angle can affect airflow - air always goes by the easiest route where there are fewer or no obstacles. On the other hand, resistance increases as air speed goes up and this relationship is not linear.

So, the airflow pattern in the setter can be very tricky. When we try to change ventilation inside of the setter, we should always evaluate the change by checking how actual eggshell temperature changes. Information about how to measure eggshell temperatures can be found in Aviagen Hatchery How To No. 6.

First published in International Hatchery Practice

Tip 26

Analyzing Egg Handling with a Thermal Imaging Camera

Thermal imaging cameras used to be large, heavy and very expensive. In the last few years smaller, much more affordable versions have become available, often as attachments for a mobile phone. This has opened up new possibilities for investigating egg handling and holding conditions.

Allowing hatching eggs to cool down promptly and evenly, and to stay cool, is very important if the eggs are to hatch well. Starting when eggs are collected from the nests, we need to make sure that embryo development is completely paused. Do we really know if all our fertile eggs are kept under ideal conditions? There may be thermometers or temperature sensors in a farm egg room or hatchery egg room that indicate temperatures in a limited number of locations, but we don't get a full picture of the thermal environment to which the eggs are exposed. Nor can we see how the cooling eggs interact with the environment.

Thermal imaging has proved to be a valuable tool for investigating not only the environment where the eggs are stored but also egg temperature in different locations within the trolley, egg boxes or pallet.

All objects emit infrared radiation (heat) that is invisible to the human eye, but can be captured by the thermal imaging camera. The camera software then converts the temperature into colors depending on the surface temperature. The final result is a picture where each color represents a specific temperature.

Thermal imaging can be used to audit eggs handling practice and conditions in farms and hatchery egg stores.

Figure 1 shows uneven temperatures in between the eggs in a farm storage room. The dark blue spots show the coldest eggs, while the orange eggs are still warm. In this case we can see that very warm eggs are brought inside the room and are being stacked on the top of eggs that are already cold, which can be a problem - each additional layer of warm eggs will re-heat the eggs that have already cooled down. Just looking at the egg room (**Figure 2**) and the read out of the room thermometer, we would not be aware that the situation is occurring and the problem would only be detected when pre- incubation is seen when opening fresh eggs.

Thermal imaging can also be useful to show if the eggs are being boxed while they are still warm, which can also cause pre-incubation in the farm or during transport. Eggs should always be allowed to cool down before being boxed into cardboard boxes. Cardboard is an effective thermal insulator and will slow cooling of the eggs if they are put into the boxes still warm. **Figure 3** shows eggs that weren't allowed to cool down before being boxed. They arrived in the hatchery still warm.

Figure 3 Eggs still warm when arrived in the hatchery egg room after transport

In the hatchery, the thermal imaging camera can be used to check that a delivery of eggs is at the correct temperature, and that all the eggs in the delivery are of a uniform temperature. Getting this stage right gives a better hatchability, because all the embryos will be properly cooled at the same time. It will also minimize the hatch spread within a batch of eggs.

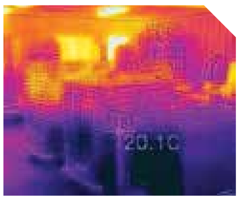


Figure 1 Thermal imaging of farm storage room

Figure 2 Normal imaging of farm storage room

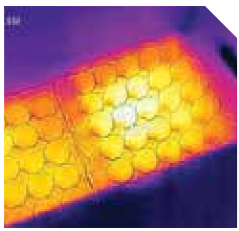


Figure 3 Transport

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Tip 27

Are you Measuring and Calculating your Chick Yield Correctly?

Most commercial hatcheries nowadays measure and use chick yield as a Key Performance Indicator (KPI) to evaluate both hatch timing and incubation. But the big question is: Are you recording your chick yield correctly?

Chick yield is the average weight of the chicks at pull, expressed as a percentage of the average egg weight at set. It tells you when the eggs are losing enough water during incubation, and also whether the chicks are being pulled at the right time at the end of the hatcher period. It is usually measured on sample trays – two or three trays per farm per set – and the full procedure is described in Hatchery How To Measure Chick Yield which is available on the Aviagen website.

It is worth auditing the procedure in your hatchery regularly to make sure that the method being used is correct, and has not drifted over time, or with changes in staff.

At the start

The fresh egg weight is based on the average weight of the eggs on a full setter tray. The empty tray weight must be measured and recorded, and subtracted from the full tray weight every single time. Even in a new hatchery, tray weights will vary; and, once they have been topped up to replace damaged units, it is highly likely that there will be between-tray differences in weight.

Check the eggs on the sample trays before they are weighed, including a quick pass over a candling table. Remove and replace any dirty eggs, any with abnormal shells and any broken or hairline-cracked eggs before the full tray is weighed.

When setting these trays, make sure to place them in different representative locations in the setter, distributed top to bottom and front to back of the incubator. Record setter number and location.

Calculate average fresh egg weight:

$$\text{Avg fresh egg weight} = \frac{\text{weight of full egg trays - weight of empty trays}}{\text{Number of eggs in tray}}$$

At Transfer

When transferring, make sure to move the labels correctly to each hatcher basket so that the final chick weight can be associated with the correct initial egg tray weight.

At Hatch

Chicks should be weighed immediately after they are removed from the hatcher.

Before weighing any chicks, place an empty chick box on the scales and zero (tare) the display. Skipping this step will give an artificially high chick weight.

It is important to count all the first class chicks from each labeled hatch basket into the empty box one group at a time. Record the number of chicks and the weight.

Don't weigh cull chicks as they will not be typical of first class chicks on the tray, and so will affect the average weight.

Calculate average chick weight for each tray:

$$\text{Average Chick Weight} = \frac{\text{All Chicks weight in the box}}{\text{Number of chicks in the box}}$$

Calculate Chick Yield %:

$$\text{Chick Yield\%} = \frac{\text{Average Chick Weight x 100}}{\text{Average Fresh Egg Weight}}$$

Record all the background details on a spreadsheet, along with the weights and calculated yield. This will allow you to check which machines are delivering the best chick yield, and to focus attention on the machines which need adjustment.

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Tip 28

If you are Heat Treating Stored Eggs to Improve Hatchability (SPIDES), how Long Should The Eggs be Kept Warm?

Aviagen's early SPIDES trials were aimed at defining the safe limits for heat treating eggs during storage – how long, how often and how hot the treatments should be. In these trials, we held eggs for 21 days, and gave up to 5 treatments during the storage period. We found that in this situation, individual treatments were best kept as short as possible. If we pushed the length and number of treatments too far, hatchability got worse. Chart 1 shows the percentage of lost hatch that was recovered after different treatment combinations, compared in terms of the cumulative time the egg shell temperature was held above 32°C (EST>32°C).

We showed that hatch recovery was achieved in any treatments where the cumulative time above 32°C was between 6 and 24 hours, but that the optimum effect was seen when the cumulative time above 32°C was 12-15 hours. There was a steady deterioration in the hatchability recovered for treatments above 15 hours, which dropped to no benefit when EST >32°C was over 26 hours and almost complete hatch failure when the cumulative treatment time was 39 hours.

The trial summarised in Chart 1 does not show what impact, if any, there might be in further shortening the cumulative exposure time from 6 hours. However, some recent trials which were performed in collaboration with Prof Okan Elibol at the University of Ankara have shown that shorter treatment times can also be suboptimal.

These trials were done using a Petersime® Re-store cabinet, and a storage period of 14 days. The eggs were treated once only, on the 5th day of storage, and were given either 3.5 or 5.5 hours above 32°C EST. There were three repetitions, using eggs from flock ages of 37, 54 and 55 weeks. There was no fresh egg control in these trials; so it was not possible to calculate how much hatch was lost due to storage, or the percentage recovery. However, in each of the three comparisons, a single exposure of 5-5.5 hours gave a higher hatchability than the shorter exposure of 3-3.5 hours.

When designing a SPIDES programme, for optimal results the treatments should be set up so that the cumulative EST>32°C is between 5 hours and 15 hours.

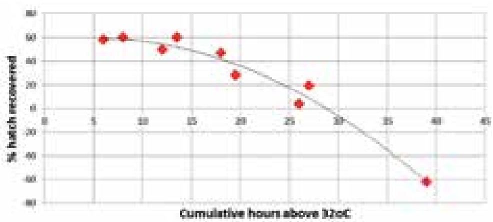

Chart 1 Percentage of lost hatchability due to storage recovered after multiple SPIDES treatments.

Figure 1

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Tip 29

Chick Weight Loss Post Pull - What is Normal?

Chicks have a natural powerful robust provision when they hatch, the yolk sac, which keeps them well supplied with food and water for a number of days until they start consuming feed and drinking water for themselves. After chicks hatch it is normal for them to lose some weight. Some of that loss will be due to the residual yolk being used up, some will be meconium passed through the vent and some will be moisture loss as they breathe. If the interval and the environment between take-off and placement on farm are good, then the weight loss is likely to be very small. However, it is useful to have some idea of what is normal weight loss when assessing situations where things have not gone as planned.

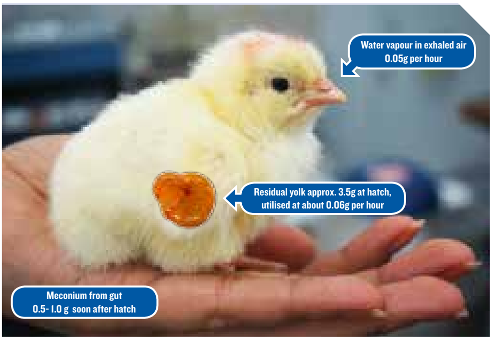

Figure 1 Sources of weight loss in the hatchling chick.

Recently, we compared weight losses of hatchling chicks across two trials. In the first, the chicks were removed from the hatcher within 6 hours of emergence, and kept for 24 hours in a climate respiration chamber held at 91.4ºF (33.3ºC) and 40-60%RH. In the second, the chicks were pulled at the end of the hatcher period after approx. 504 hours incubation and held in chick boxes in the hatchery, also for 24 hours. Hourly weight loss over the 24 hours post hatch was 0.11g in both trials.

In summary, **Figure 1** shows the normal losses under optimal environmental conditions which keep the chicks comfortable: around 0.05 g/hour water vapourisation in exhaled air. Furthermore, the meconium will leave the gut soon after hatch, which means a loss of about 1 g. Then, in addition, chicks have in their yolk sac residual yolk of about 3.5 g at hatch, which will be used at a rate of about 0.06 g per hour. After 24 hours, the chicks had lost between 9 and 10% of their weight at take-off.

In the field, under less optimal holding conditions, higher weight losses in 24 hours are often observed. This is especially common if the chick holding area is too hot. Chicks will start panting, a common mechanism to get rid of surplus heat, if their vent temperature reaches 105°F (40.5 °C). Panting chicks will lose more weight and this is probably one of the factors causing dehydrated chicks when they are observed in the field.

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Tip 30

How to Calibrate and Use Temperature Readings taken with Tiny Tag Loggers

Over the last 20 years, the importance of controlling embryo temperature, as indicated by egg surface temperatures (EST), has become well understood. It is now very simple to record EST, using miniature data loggers with an external flexible thermistor probe such as the Tinytag made by Gemini Data Loggers (https://www.geminidataloggers.com/data-loggers/tinytag-talk-2/tk-4023). The Aviagen Hatchery How Tos No 3 and 6 describe how to measure egg shell temperature, and where best to place the probes in different types of machine.

Temperature loggers will save records of EST within a setter, the data can be analyzed and displayed in different ways and the record can cover the entire time eggs are in the setter. Their unit cost is low enough that several can be set up in a machine, to assess temperature variability. Their main disadvantages are that the loggers cannot be read in real time (newer models can be read in real time through a wifi or radio link, but they are more expensive), the records are accurate only to 0.5°C and the probes cannot be recalibrated by the user. However, there is a way to check a batch of loggers so that differences between loggers can be identified and corrected as necessary.

Checking between-logger variability

Tiny tags do not have a calibration option. However it is possible to check the variability of readings obtained within a batch of loggers, and correct the temperatures recorded using a simple excel calculation. For this purpose:

- Identify each thermistor/logger with a number
- Hold all the thermistors together using adhesive tape and place them into a setter containing day 2 - 4 day eggs for at least an hour as shown in **Figure 1**:-

Figure 1

- Download and export the data from all the loggers into Excel
- Calculate the average temperature readings of the last 30 minutes for each logger
- Take one logger as the reference (the one closest to the average) and calculate how much each of the others loggers differ from this reference probe.

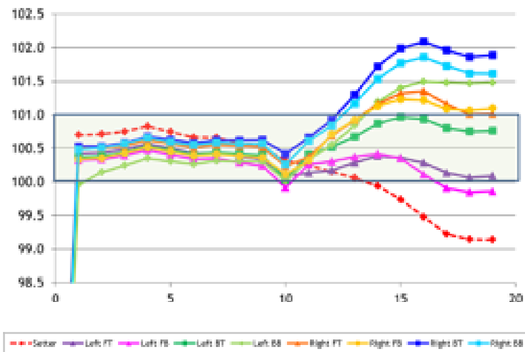
		1	2	3	4	5	6
1	26/07/2016 09:05:01	99.367 ºF	100.075 ºF	99.863 ºF	100.115 ºF	99.971 ºF	99.247 ºF
2	26/07/2016 09:05:06	99.367 ºF	100.072 ºF	99.857 ºF	100.112 ºF	99.965 ºF	99.253 ºF
3	26/07/2016 09:05:11	99.367 ºF	100.072 ºF	99.851 ºF	100.115 ºF	99.958 ºF	99.259 ºF
4	26/07/2016 09:05:16	99.367 ºF	100.072 ºF	99.845 ºF	100.115 ºF	99.955 ºF	99.265 ºF
5	26/07/2016 09:05:21	99.370 ºF	100.069 ºF	99.835 ºF	100.112 ºF	99.949 ºF	99.272 ºF
—	—	—	—	—	—	—	—
355	26/07/2016 09:34:31	99.312 ºF	100.072 ºF	99.675 ºF	100.140 ºF	99.900 ºF	99.259 ºF
356	26/07/2016 09:34:36	99.305 ºF	100.069 ºF	99.685 ºF	100.121 ºF	99.894 ºF	99.250 ºF
357	26/07/2016 09:34:41	99.296 ºF	100.069 ºF	99.688 ºF	100.106 ºF	99.885 ºF	99.238 ºF
358	26/07/2016 09:34:46	99.287 ºF	100.066 ºF	99.691 ºF	100.088 ºF	99.878 ºF	99.222 ºF
359	26/07/2016 09:34:51	99.275 ºF	100.063 ºF	99.694 ºF	100.069 ºF	99.872 ºF	99.204 ºF
360	26/07/2016 09:34:56	99.262 ºF	100.063 ºF	99.694 ºF	100.054 ºF	99.866 ºF	99.182 ºF
		99.802 ºF	100.097 ºF	99.717 ºF	100.164 ºF	99.934 ºF	99.223 ºF
	Average of all loggers	99.825 ºF					
	Corrections	0.000	0.295	-0.075	0.362	0.132	-0.519
*Probe 1 is the closest to average							

- Install the loggers in a setter for a full run, following the methods described in How Tos 3 and 6
- After completing the run, apply corrections to each logger before any further analysis

Once corrected, the EST values can be plotted versus time, to show where hot and cool spots lie within the machine, and also how temperatures change and become more variable during incubation.

As an example, in the chart below, sensors were placed at the top and bottom of trollies at the back and front of the machine, to the left and right of the central fan. Temperatures for each 24 hour period have been averaged, to remove temporary blips during machine checks and variability due to egg turning. The red line shows the air temperature at the sensor, which was warmer than the EST readings until 6 days, and cooler after 12 days. At 17 days:

- EST at the right hand side of the machine was warmer than at the left (101.5ºF vs 100.6ºF)
- The front of the machine was cooler than the back (100.6ºF vs 101.5ºF)



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Tip 31

Use Water Loss Data to Assess Setter Function

The water loss of hatching eggs will affect hatchability and chick quality. The ideal weight loss from 0-18 days is between 10.5-12.5%. The main factor affecting incubation water loss is the humidity of the air in the setter. Most hatcheries monitor water loss and use it as an effective management tool to fine tune setter humidity programmes.

But sometimes, the water loss varies between machines or in different hatches over time, even when the setters are all running with the same humidity programmes and set-points. When this sort of variability is seen, it is usually because the humidity levels achieved in the setter have been affected by factors such as the humidity of the fresh air coming in to the setter, its ventilation rate or the functionality of the humidifier inside the machine. If one of these factors has changed even slightly, or is not working properly, water loss may change. So we can also use water loss data to assess the functioning of a hatchery. Here are some examples.

1. This was in a hatchery located in a temperate climate. The air supply to the setters was not humidity controlled. But warm air in the summer can hold more moisture, so actual incubation humidity is much higher and the eggs lose less weight (see **Chart 1**).

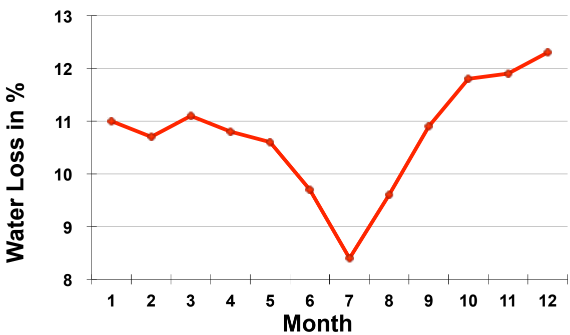

Chart 1 Water loss profile in a hatchery showing the effect of season when the air supply is not humidity controlled

2. A different hatchery, again in a temperate climate. This hatchery had four setter rooms. Room 1 held setters 1-6, room 2 setters 7-12, room 3 setters 15-19 and room 4 setters 20-24. Setter rooms 1 and 3 shared one exhaust plenum. Setter rooms 2 and 4 shared another one. After the exhaust fan was changed on the plenum for setter rooms 2 and 4, incubators in these two rooms were ventilated more than the others, causing relative humidity to be lower and as a result the eggs lost more weight (see **Chart 2**).

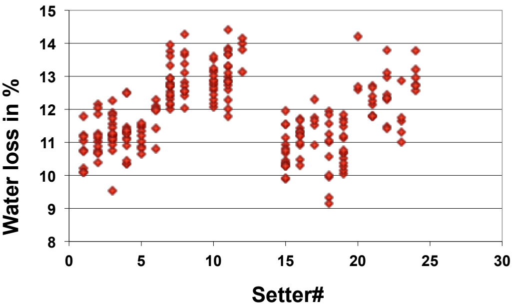

Chart 2 Water loss in different setters due to differences in exhaust plenum ventilation

3. A third hatchery, located in a hard water area. Water for humidification was taken directly from the tap. In Setter No.6, the nozzles were blocked due to the hard water (see **Figure 1**). As a result, incubation humidity was lower and the eggs lost much more water (See **Chart 3**).

Figure 1 Blocked spray nozzles in setter No. 6

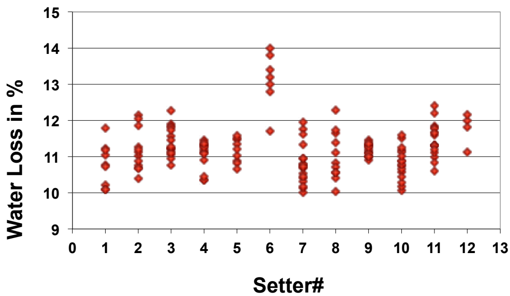

Chart 3 Eggs in setter 6 lost more water due to low humidity

The three examples in this tip show how the local environment can affect humidity in different parts of the hatchery. If the issues are not identified and corrected, water loss will not be in the optimum range, and hatchability and chick quality will suffer.

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Tip 32

How to Calculate Water Loss Correctly

Correct egg water loss during incubation is important for hatchability and chick quality. Water loss is controlled by incubator humidity and critical to correct measurement of egg water loss is the correct calculation.

Water loss is the average weight of the eggs at transfer expressed as a percentage of the average egg weight at set. It is usually measured on 3 sample incubator trays from each breeder flock in each set. Trays should be placed in the incubator so that one is positioned near the top, one near the middle and one near the bottom of the incubator rack. The full procedure is described in Hatchery How To Measure Egg Water Loss, which is available on the Aviagen website.

Based on the procedure, water loss can be calculated as;

$$\% \text{ Water loss} = \frac{\text{Full tray weight at set} - \text{Full tray weight at transfer}}{\text{Full tray weight at set} - \text{Empty tray weight}} \times 100$$

If incubated correctly, eggs lose on average 11-12% of their weight by transfer at 18 days. Although the calculation by itself is simple, there are some important points to be aware of for the accuracy of calculations;

- Do not use a standardized weight for the empty trays. Setter tray weight can differentiate depending on tray production lots, quality of materials, degradation over time etc. To have an accurate result, empty trays must be weighed for every tray of eggs.
- Do not include dirty eggs with abnormal shells and broken or hairline-cracked eggs. These eggs will lose more water and consequently show higher water loss than normal.
- If egg transfer is not done at 18 days, the calculated water loss needs to be corrected to 18 days for accuracy and appropriate quality control.

Example: Eggs are transferred at 19 days and water loss is 12.5%. Water loss corrected to 18 days can be calculated as;

$$\left(\frac{12.5}{19}\right) \times 18 = 11.8\%$$

- During storage hatching eggs will lose about 0.5% per week and this number should be included in the total loss at transfer. For example: If the eggs lose 11.8% between setting and transfer (18 days) but are stored for one week before setting, the total moisture loss between laying and transfer will be 11.8 + 0.5 = 12.3%.

Egg water loss measurement has been implemented in most commercial hatcheries as a powerful tool of quality control for the incubation process. In order to have good information, correct calculation is critical to obtain accurate results.

Figure 1

First published in International Hatchery Practice

Tip 33

Checking Fresh Eggs for Unwanted Embryo Development

The best way to look after hatching eggs is to collect them from the nests as often as possible (ideally 4-5 times per day), disinfect the shell surfaces, let them cool evenly and slowly and then hold them at around 15°C until they are placed in the setter. It is important that conditions are even throughout the mass of eggs, and that temperatures are not allowed to fluctuate. It is especially important to keep the eggs below physiological zero – the temperature above which embryo development is possible.

When eggs cool unevenly, some of them will develop a lot further than others. After 18 days of incubation this range will be enough to widen the hatch window significantly, with the quality of the earliest hatching chicks suffering accordingly. Eggs held at temperatures which fluctuate around 20-24°C will show distinct signs of embryo development which if allowed persist for too long will give higher levels of early embryo mortality.

There are several ways to check egg-holding temperatures using simple technology. A max-min thermometer, read twice a day and the results plotted manually on a daily graph will tell you if the storage room is suitably insulated, cooled and heated for the local climate. Data loggers such as Tinytags can measure egg shell temperature at any point in the egg mass, highlighting temperature fluctuations over time. Several loggers, suitably located, will show if the room conditions are uneven. A cheap thermal imaging add-on for a smart phone will show hot and cold spots within the egg store.

At a biological level, it can be helpful to look at the embryos directly, using hatching eggs from the flock of interest. (Don't use floor or cull eggs – they will have been held under different conditions to the hatching eggs). This can be done as a one-off, or more usefully as part of a regular sampling program. The work must be done in an area with good bright light. Label each egg to show date, flock and location it was taken from. Use forceps to make a small opening at the very top of the large end of the egg. Remove the shell and membranes around the hole, to expose the germinal disc without damaging it (the yolk will always float so that the germinal disc is at the top, so will be easy to find.) Check that the egg was fertile (Hatchery How to 4) and sort the fertile embryos into order of size.

Figure 1 Appearance of a normal embryo when the egg is laid and cooled promptly.

Tip 33 (cont.)

Checking Fresh Eggs for Unwanted Embryo Development

Embryo development takes place for 24 hours after fertilization as the egg forms around the ovum. When the egg is laid there will be 30-60,000 cells in the blastoderm, which will have reached Stage X of development. Unmagnified, the embryo will look like a ring doughnut, with a transparent area in the middle of the ring – the area pellucida.

Once the egg is laid, provided that holding conditions are correct, there should be no more development. However, if the rate of cooling is uneven, or the eggs are held in fluctuating temperatures then some or all of the embryos will continue to develop past Stage X.

Figure 2 Eggs opened in the hatchery after uneven cooling, showing very variable embryonic growth.

Some of these embryos had developed past the stage that they would survive the holding period, and even those which would be able to start developing again will develop to produce a very wide, hatch window. To stop this pattern being a regular part of embryo development in your hatchery, check sample eggs from positions you have concerns about and correct the problem as soon as possible.

First published in International Hatchery Practice

Tip 34

Hitting the Chick Yield Target

The process of converting a fertile hatching egg into a chick is dependent on getting several key factors right. Like some other of the incubation essentials (especially embryo temperature and moisture loss to 18 days), chick yield is something of a Goldilocks trait – the chicks should not be too dry, nor too wet but just right. Chick yield is driven not only by incubation humidity and egg moisture loss but also by elapsed time in the incubator and it is important to remember this when considering the optimal chick yield for an operation, because chick yield doesn't only indicate hydration status, but also maturity. When chasing chick quality, both are important, and it is counterproductive to chase higher levels of hydration while sacrificing maturity.

We advise that chicks should fall into the band of 10.5-12.5% weight loss to 18 days and 67-68% chick yield at pull. Observation of trial hatches has shown that batches of eggs can be surprisingly good at recovering from 18 day weight losses which are too high or too low, ending up with an acceptable chick yield at hatch. Other batches achieved perfect 18 day moisture loss, but chick yields which were well outside target levels.

In a recent investigation, the Aviagen hatchery team audited hatcheries for a large scale integration. One of the factors considered was chick yield, and also the incubation time normally given at that hatchery (counted from the setter coming up to temperature until the chicks were pulled from the hatcher to be sent to the farm). The incubators involved covered a huge range of types, from old multi-stage to brand new single-stage units. Each hatchery manager decided what the incubation time should be, based upon his own knowledge and experience. Each hatchery was hatching the same broiler breeder line.

It can be seen from **Figure 1** that there was a considerable range in the hatching times – from 499 hours to 522 (21 days is 504 hours). Indeed, incubation time accounted for almost half of the variability in chick yield across the business.

Subjected to regression analysis, other factors which might be expected to affect chick yield, such as weight loss to 18 days, and the number of days the setters were run sealed did not have a significant effect on chick yield at hatch.

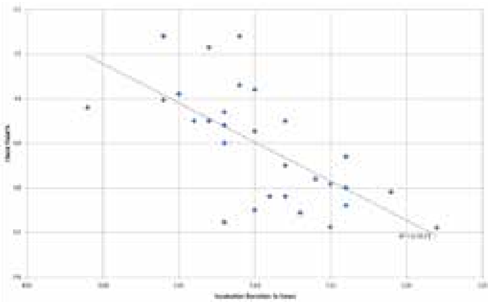


Figure 1 Chick Yield vs Incubation Duration

Chicks which are pulled too early, with a chick yield over 69%, will have relatively poorly healed navels, and be more susceptible to handling and impact damage. To reduce the chick yield by 1%, the chicks will need 5 hours longer incubation time. This is probably most easily achieved by setting the eggs earlier; taking good care that the hatcher temperatures are kept under tight control once the chicks are out, aiming to keep vent temperatures between 103 and 105oF (39.4-40.5oC).

First published in International Hatchery Practice

Tip 35

Do we Supply Enough Air to our Incubators?

Incorrect ventilation is a common problem in hatcheries. Even if the basic hatchery ventilation has been correctly specified, the various components need to be installed, calibrated and set up properly. Air pressures must be correct in each room, and the volumes entering the room must be enough to meet the needs of the embryo, and also to maintain room air pressures. If a hatchery has been extended, it is quite common that the ventilation capacity is either not increased at all, or not increased sufficiently for the number of extra incubators.

There are several ways to check if ventilation rates are meeting the hatchery's needs. Room air pressures, supplied air volumes and CO_2 levels are all good indicators. This tip will explain how to calculate the supplied air volumes – the same method can be used to check air handling units or exhaust capacities.

Each brand and model of incubator has its own specific ventilation needs. For optimum performance, we have to supply the correct pressures and air volumes for the make of machine installed in the hatchery. These will have lower and upper limits, so keeping them on the average level will bring some energy savings when compared to keeping everything at the upper limit.

To measure the air intake of a machine, first we need to know the minimum and maximum fresh air needs, which should be specified by the manufacturer. For the calculations, we will need an air speed meter (anemometer), a ruler and a calculator. All the measurements will be done from the machine air inlet area. Depending on the make of incubator, the air inlets may be placed in front of the machine or in an air supply plenum. Before taking any measurements, the dampers will need to be fully opened. Avoid windy days for this procedure.

Equipment

- Anemometer (Kestrel make multi meters which include a suitable vane anemometer)
- Ruler
- Calculator

Preparation

- Find the air inlets for the setter or hatcher
- Remove any obstructions, such as a grill
- Open all dampers to 100% open
- Close all room doors, and check static pressures are balanced for that room

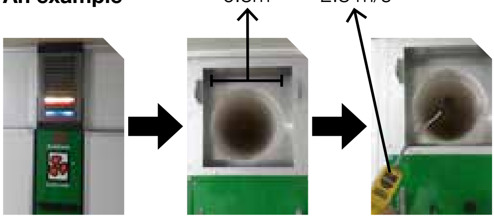
Measurements and Calculations

- Measure the dimensions of the air inlet
- Calculate the cross sectional area = $\pi \times (\text{diameter}/2)^2$ where $\pi = 3.14$
- Measure the average air speed in front of the inlet
- Use the formula to calculate air intake

$$\text{AirIntake} = \underset{(m/s)}{\text{Air Speed}} \times \underset{(m^2)}{\text{Cross Section Area}} \times 3600$$

- This formula will calculate airspeed in m^3/hour. To convert to cfm (cubic feet per minute) multiply the metric result by 0.588578

An example



$$\text{Cross Section Area} = \pi r^2 = 3.14 \times \left(\frac{0.3}{2}\right)^2 \cong 0.07m^2$$

$$\text{Air Intake} = \underset{(m/s)}{\text{Air Speed}} \times \underset{(m^2)}{\text{Cross Section Area}} \times 3600$$

$$= 2.8 \text{ X } 0.07 \text{ X } 3600 \cong 705 \text{ m}^3/\text{h}$$

Converting m^3/h to cfm : m^3/h X 0.588578

$= 705 \text{ X } 0.588578 \cong 415$ cfm

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Tip 36

Chick Box Layout for Laminar Ventilated Chick Holding Rooms

Ideally, chicks should be delivered to the farm as quickly as possible after they come out of the hatcher. However, there may need to be a period of time when they are held in the hatchery before they are dispatched to the farm. In such cases, chick holding conditions in the hatchery are important and the way in which the room ventilation is managed can make a big difference.

When it comes to chick holding room ventilation, there are two different systems which are commonly used. In a vertical ventilation system, air is moved vertically by roof-mounted fans. The chick boxes should be distributed evenly and placed at least 10cm apart from each other. The second system is a laminar ventilation system. In these, fans are wall mounted and the air travels parallel to the floor. For a laminar air flow system to work properly, the chick boxes need to be placed in lines. This tip concentrates on laminar chick holding room ventilation and the optimal chick box placement pattern.

A typical laminar ventilation system is shown in **Figure 1** below. The system is simple; from one side air supply fans push air into the room and from the opposite side extraction fans take out the same volume of air. In this way, a low-pressure area is created between the chick boxes, which will draw the hot and dirty air from inside the boxes.

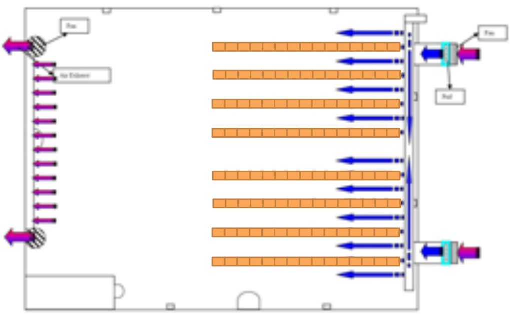
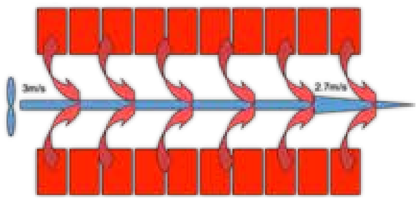


Figure 1 A typical laminar flow ventilation system for a chick holding room.

A common mistake with these systems is to leave spaces between chick boxes within a row. The air will as usual follow the easiest and shortest route, moving into the gaps in the line, and as a result loose its velocity before the end of the row. Once the chick boxes are placed as a line without spaces (see **Figure 2** below), air will keep moving between the lines of boxes and will create low pressure area in the middle. This low-pressure will pull the dirty and hot air out of the boxes replacing it with clean air.

Right



Wrong

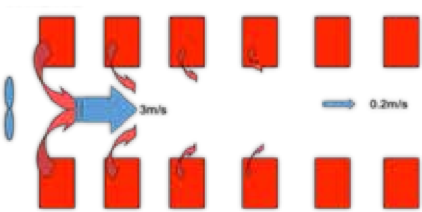


Figure 2 Comparison of chick box layout and resulting air speeds in properly and incorrectly laid out rooms.

Laminar flow systems can be supported by cooling pads. Especially valuable in dry and hot areas, evaporative cooling pads will cool down the air while increasing the humidity of the chick holding area. As evaporative cooling is not effective in hot and humid areas, here the system needs to be supported by an air conditioning unit.

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Tip 37

Making the Most of your Hatchery Data.
Using Pivot Tables to Boost Hatchery Management

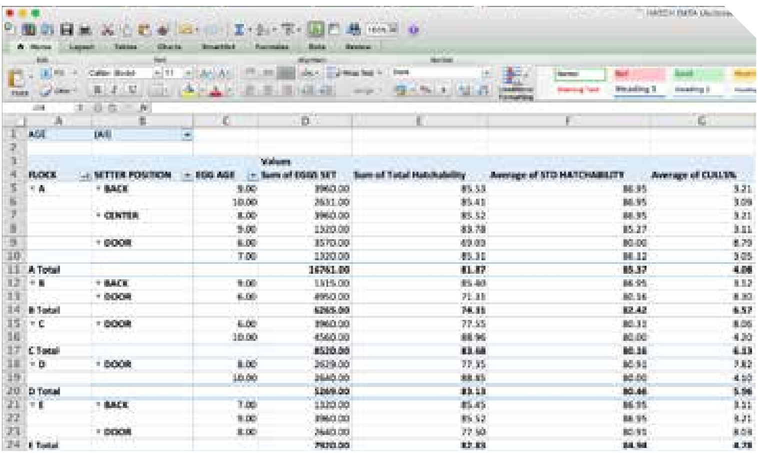
Almost every Hatchery manager assesses his results by collecting performance data such as hatchability, hatch of fertile, water loss, hatch debris, mortality patterns, percentage of culls and first week mortality. But the best way of keeping track and using the information to manage the hatchery is by analyzing the data collected as a whole, identifying how each key performance indicator (KPI) is performing and checking how they are interrelated. There is no point in collecting vast quantities of data if you cannot then make good use of them. Keeping data on sheets of paper stored in desk drawers will not help you boost your KPI's.

Nowadays, with data collection being a routine component of day-old chick production, there are many sophisticated tools available to track the hatchery environment. Data loggers can collect real time data describing (for example) temperature, humidity or CO_2 using remote sensors and transmitting the information to a networked computer, a tablet or even a cell phone. However, no matter how much easier data collection has become, the information still needs to be summarized and used to correlate cause and effect.

The best way of summarizing all the data collected is by putting it into a database or spreadsheet in such a way that all the information can be analyzed as a whole, looking closely at details where necessary.

Excel is one of the most widely available programs for data analysis, and many people working in a hatchery will have some familiarity with it. While not everybody uses them, it is full of surprisingly sophisticated tools for analyzing data, and can cope with very big data sets. As such, it can provide rich information for improving a hatchery's KPI's.

Avoid producing daily report sheets as they are difficult to analyze. A better way is to consolidate the data, and then use Pivot tables to control process and KPI's. **(Figure 1)**



AGE	(All)					
			Values			
FLOCK	SETTER POSITION	EGG AGE	Sum of EGGS SET	Sum of Total Hatchability	Average of STD HATCHABILITY	Average of CULLS%
A	BACK	9.00	3960.00	85.53	86.95	3.21
		10.00	2631.00	85.41	86.95	3.09
	CENTER	8.00	3960.00	85.52	86.95	3.21
		9.00	1320.00	83.78	85.27	3.11
	DOOR	6.00	3570.00	69.03	80.00	8.70
		7.00	1320.00	85.31	86.12	3.05
A Total			16761.00	81.87	85.37	4.08
B	BACK	9.00	1315.00	85.40	86.95	3.12
	DOOR	6.00	4950.00	71.31	80.16	8.80
B Total			6265.00	74.31	82.42	6.57
C	DOOR	6.00	3960.00	77.55	80.31	8.06
		10.00	4560.00	88.96	80.00	4.20
C Total			8520.00	83.68	80.16	6.13
D	DOOR	8.00	2629.00	77.35	80.91	7.82
		10.00	2640.00	88.85	80.00	4.10
D Total			5269.00	83.13	80.46	5.96
E	BACK	7.00	1320.00	85.45	86.95	3.21
		9.00	3960.00	85.52	86.95	3.21
	DOOR	8.00	2640.00	77.50	80.91	8.08
E Total			7920.00	82.83	84.94	4.78

Figure 1 Example of how a Pivot table can combine different data.

Pivot tables allow the user to create any kind of report needed in order to evaluate different KPI's, machines or data loggers in one unique screen. Moreover they are easily manageable by any Excel user, just requiring a little training.

The most important step is making sure that your data is organized following a database layout as shown in **Figure 2** (organized in columns, consistent naming, data within acceptable ranges, sensible data without errors).

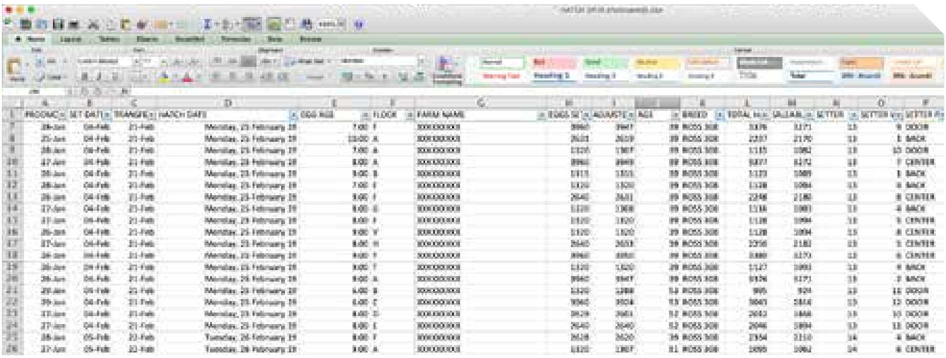


Figure 2 Example of a good data base layout for Excel.

Once set up to your satisfaction, Pivot tables can be used to generate dynamic graphs, updated each time the Pivot table is run. These can show data over several seasons, allowing the manager to evaluate trends which can be really helpful in Hatchery troubleshooting allowing the manager to compare different banks of setters/hatchers, individual machines as well as the seasonal variability which can so affect hatchery performance.

Once data driven performance management is implemented, it is possible to set targets, look at data as whole, monitor performance, analyze trends and differences and implement improvements in specific aspects which are affecting Hatchery performance.

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