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. It is important to remember this when considering the optimal chick yield for an operation, because chick yield does not 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 Fig. 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.

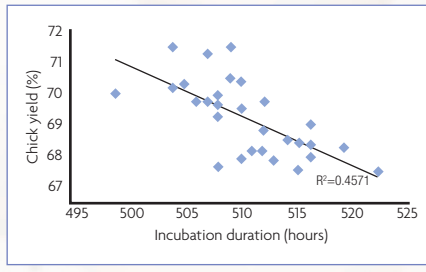

Fig. 1. Chick yield versus incubation duration.

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 five 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, and aiming to keep vent temperatures between 103 and 105°F (39.4-40.5°C).

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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 and 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 = π x (diameter/2)^2

where $\pi = 3.14$

- Measure the average air speed in front of the inlet
- Use the formula to calculate air intake:

Air intake = air speed (m/s) x cross section area (m^2) x 3600

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

An example

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

Air intake = air speed (m/s) x cross section area (m^2) x 3600

= 2.8 x 0.07 x 3600 $\cong$ 705m^3/h

Converting m^3/h to cfm:

m^3/h x 0.588578 = 705 x 0.588578 $\cong$ 415cfm

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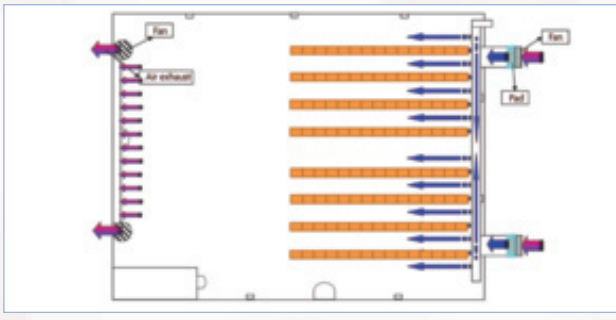
CHICK BOX LAYOUT FOR HOLDING ROOMS

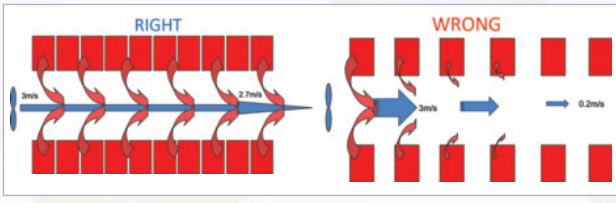
Ideally, chicks should be delivered to the farm as quickly as possible after they come out of the hatcher. However, there may need to be a period of time when they are held in the hatchery before they are dispatched to the farm. In such cases, chick holding conditions in the hatchery are important and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



A common mistake with these systems is to leave spaces between chick boxes within a row. The air will follow the easiest and shortest route, moving into the gaps in the line and, as a result, lose its velocity before the end of the row. Once the chick boxes are placed as a line without spaces, 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.



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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MAKING THE MOST OF YOUR HATCHERY DATA

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 analysing 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 KPIs.

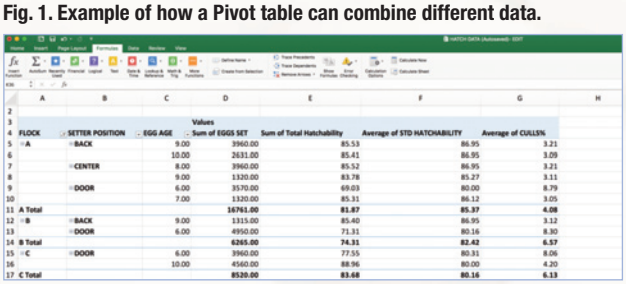
Nowadays, with data collection being a routine component of day-old chick production, there are many sophisticated tools available to track the hatchery environment. Data loggers can collect real time data describing (for example) temperature, humidity or CO_2 using remote sensors and transmitting the 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 summarised and used to correlate cause and effect.The best way of summarising all the data collected is by putting it into a database or spreadsheet in such a way that all the information can be analysed 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 analysing data, and can cope with very big data sets. As such, it can provide rich information for improving a hatchery's KPIs.

Avoid producing daily report sheets as they are difficult to analyse. A better way is to consolidate the data and then use Pivot tables to control process and KPIs (Fig. 1). Pivot tables allow the user to create any kind of report needed in order to evaluate different KPIs, 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 organised in columns, with consistent naming, data within acceptable ranges, sensible data without errors, etc.

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, and 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 a whole, monitor performance, analyse trends and differences and implement improvements in specific aspects which are affecting hatchery performance.

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



	A	B	C	D	E	F	G	H
2								
3				Values				
4	FLOCK	SETTER POSITION	EGG AGE	Sum of EGGS SET	Sum of Total Hatchability	Average of STD HATCHABILITY	Average of CULLS%	
5	⊟A	⊟BACK	9.00	3960.00	85.53	86.95	3.21	
6			10.00	2631.00	85.41	86.95	3.09	
7		⊟CENTER	8.00	3960.00	85.52	86.95	3.21	
8			9.00	1320.00	83.78	85.27	3.11	
9		⊟DOOR	6.00	3570.00	69.03	80.00	8.79	
10			7.00	1320.00	85.31	86.12	3.05	
11	A Total			16761.00	81.87	85.37	4.08	
12	⊟B	⊟BACK	9.00	1315.00	85.40	86.95	3.12	
13		⊟DOOR	6.00	4950.00	71.31	80.16	8.30	
14	B Total			6265.00	74.31	82.42	6.57	
15	⊟C	⊟DOOR	6.00	3960.00	77.55	80.31	8.06	
16			10.00	4560.00	88.96	80.00	4.20	
17	C Total			8520.00	83.68	80.16	6.13	

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Aviagen

Hatchery TIPS 40

MEASURING VENT TEMPERATURES ACCURATELY

We know that newly hatched chicks cannot control their body temperature very well, and need some help by keeping the environment close to their needs. It is easy to tell from the chicks' behaviour whether they are too hot or too cold. Hot or cold chicks also tend to be noisy. By checking their body temperature you can quantify how hot or cold they are, compared to the Aviagen target of 103-105°F, and make adjustments to the environment accordingly. This hatchery tip gives some hints as to the best way to get repeatable, accurate results when checking chick temperatures.

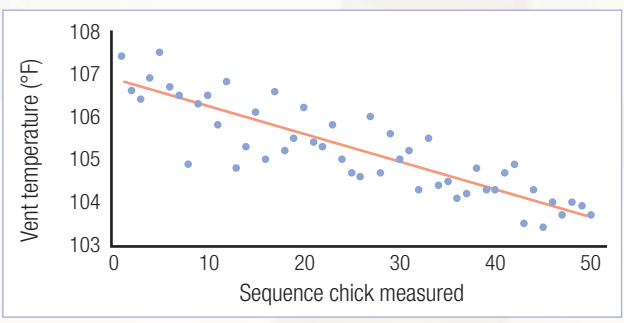
All the Aviagen trials measuring vent temperature have used a Braun Thermoscan thermometer. These are widely available, well priced and consistent. Of the current models, the Thermoscan 5 or 7 are the most suitable, because they pre-heat the measuring tip. However, they should still be checked regularly, and we advise replacing the unit every 12 months. There are other excellent paediatric infrared (IR) thermometers available, but these may give slightly different readings. So if you want to use an alternative, calibrate it against a Braun device. Switch the thermometer on and leave to settle in the room where it will be used for 15-20 minutes at the start of any measuring session.

To measure vent temperature, hold the chick with its vent towards you, and use your thumb to push the rump upwards. The tip of the thermometer should be placed on the area free of any down. If the vent is wet, after a dropping has been passed, then any visible moisture should be blotted away, or another chick sampled – a chick with a wet vent will appear to have a much lower temperature than others in the group.

Once moved to a different environment chick temperature will change quite fast. Fig. 1 shows the temperature of 50 chicks in the order they were measured. They had been moved from a hot environment to a cooler one just before measurement started. Whenever possible, chicks should be measured in the place where they are being held. If they have to be moved, for example out of a hatcher or a delivery vehicle, then the vent temperatures will only be representative of the former environment for around 15 minutes. After this time, a new sample should be taken.

Vent temperatures can give accurate and repeatable guidance to the comfort of chicks at all stages between hatching and arriving at the farm. Take care to measure accurately, record the data to place and time and use it to make improvements to the environment for the chicks.

Fig. 1. Vent temperatures dropping as a box of chicks adjusts to a cooler environment.



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HOW TO OPTIMISE THE TIMING OF IN OVO VACCINATION

When using in ovo vaccination in your hatchery, several important decisions need to be made about the way in which it is organised and delivered. Two key points are:

- When to vaccinate
- The correct point on the egg surface to apply the vaccine

So how do you establish the best time (stage of development) to carry out the vaccination? This can often be overlooked, people preferring to vaccinate according to organisational convenience rather than aiming to optimise embryo response. For in ovo vaccination to be effective, the vaccine must be delivered to the amniotic fluid or into the embryo itself. If deposited in the yolk, the allantoic fluid or the air cell of the egg it will not work well. Suppliers of in ovo vaccines and vaccination systems advise vaccinating between 18 days 12 hours and 19 days.

Regardless of the pre-determined vaccination time, it is helpful to monitor embryo development through visual evaluation of sample embryos just before vaccination. Use the information collected to optimise the time when eggs are vaccinated: the optimum time is when the yolk is being pulled into the abdomen.

Many factors can widen the spread of hatch time, so it is worth doing some strategic checks on factors known to increase hatch spread (see below) and adjusting vaccination time or, if appropriate, correcting them if shown to be an issue.

Samples need to be taken at different places in the incubator to identify whether chronological age and physiological age are close, because any divergence may directly influence the site of application and therefore the effectiveness of the in ovo vaccine. Vaccination must start before internal pipping, again because the embryos may not be in the ideal position to receive the vaccine and so it will not be delivered to the appropriate place.

For maximum vaccination impact, we must pay attention to the uniformity of embryo development at the time of vaccination.

This can be affected by:

- Type of incubation (single stage x multiple stage)
- High or low temperature and humidity
- Problems with turning angles below 38°
- Inadequate ventilation
- Age of the breeders
- Size, weight and shape of eggs
- Storage duration of the eggs
- How long the eggs have been incubated and the development stage reached by the embryos. This may be affected by egg age at set, breed (for example, Ross 708 hatch faster than Ross 308) and generation (broilers hatch faster than parent stock).

These factors can directly influence the effectiveness of vaccination, hatchability and chick quality.

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USING YOUR MOBILE AS A POWERFUL TOOL IN THE HATCHERY

A mobile application, most commonly referred to as an app, is a type of software designed to run on a mobile device, such as a smartphone or tablet computer. Mobile applications frequently serve to provide users with easy measurement and analysis which are equivalent to those provided by dedicated tools. App software is supplied through application stores managed by Apple® or Google®. Today there are many applications which can be used in hatcheries:

Angle measurement

To check egg turning angles or ventilation damper angles the mobile device can be used as an angle meter. Angle Meter Pro is available for both IOS and Android, and can even measure angles through a window if necessary.

Converting units

Globally, manufacturers give standards for flows, volumes or pressures in different units. The actual units chosen will usually depend on where the supplier is based. Depending on the measurement tools or calculation methods actually in use at the hatchery, it is often necessary to convert these values to different units. These small applications are capable of converting almost all values. There are hundreds of similar programs available for IOS and Android.

Measuring fan speeds

Fan speed checks are an essential part of routine maintenance. These applications use the mobile device's flash light as a tachometer. To measure fan speed, start the application, set the expected RPM (Revolutions per Minute) value to the target for that machine, and in the dark direct the blinking light towards the fan and observe the fan blades. If the fan looks as if it has stopped turning, then it is turning at the expected RPM value. If it still looks as if it is turning, alter the expected RPM from the menu and read its current speed. It is possible to multiply the RPM by the number of fan blades for easy reading.

Converting between RH% and F

Many hatcheries have more than one make or age of machine. When recording humidity, some machines use relative humidity % (RH%) and others wet bulb temperature. This tool will convert between the two. It is also useful if you are calibrating an electronic humidity sensor which is programmed to give a wet bulb reading. Set machine air temperature and expected RH% on the app, which will give a predicted wet bulb reading. The app can also be useful calibrating machines with electronic humidity sensors, which are calibrated using saturated salt solutions but give the humidity reading as a wet bulb temperature. For this, you need to tell the app the incubator air temperature in F (Farad), and the predicted RH reading from the salt solution. The app will tell you what the wet bulb temperature should be, which you can check against the actual reading on the incubator. If the two are not in agreement, adjust the machine reading until it is the same as the one on the app.

The apps that are available for smart phones include many which are of great practical value. The few that we mention in this tip cover those which are particularly useful in the hatchery and are available at low or no cost to the user.

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Aviagen

Hatchery TIPS 43

CORRECT USE OF LOGGERS TO MEASURE EGGSHELL TEMPERATURE

Incubation temperature plays a critical role in chick quality and hatchability. Because the temperature of the outside surface of the egg shell is very close to that of the embryo inside it, more and more hatcheries are using temperature loggers routinely to measure eggshell temperature.

There is good research evidence to show that the optimal embryo temperature lies between 37.8-38.3˚C all the way through incubation. The embryo's heat production increases steadily through incubation. This means that the air temperature settings need to be changed regularly to deal with the increasing amount of embryo heat being generated.

Once we start to measure eggshell temperatures, we can use the information to improve hatchery performance by:

- Fine-tuning air temperature set-points or programme, so that the actual eggshell temperature sits in the ideal range throughout the whole incubation period.
- Finding eggshell temperature variation within a setter or between setters; thus identifying and allowing us to fix setter maintenance issues, so that all the eggs in a hatchery experience very similar incubation temperature.

One of the devices commonly used to measure eggshell temperature is the Tinytag Talk-2 Model-4023, connected to a thermistor probe. It can measure and record eggshell temperature continuously at pre-set intervals throughout incubation. Once set up, the incubator can work undisturbed – this is a big advantage in machines with no corridor or space for a person to work safely while the machine is running.

Temperature data loggers of this type are useful and powerful tools. However, there are ways to optimise the quality of the data collected.

- Check and calibrate the loggers and probes first.
- Attach the probe to the egg. We tested different materials to attach the probes, and found that a thumb-nail size lump of Blu-Tack gives the most stable results (see photo).

- There are several factors which can make a difference to the absolute value of the temperatures recorded.

– The temperature over the air cell will be too high in early incubation and too low after seven days – place the probe on or below the equator.

– Infertile eggs will not generate any embryo heat later in incubation, so will tend to under read after eight days. If starting recording at day 0, the sample eggs should be candled and if necessary replaced at 6-8 days.

– Every time eggs are turned, the change in wind speed and direction across the thermistor will show in a change of temperature. Place the thermistor on the side of the egg away from the fan to minimise this.

- At the end of incubation, gather all the data into an Excel file and plot the traces collected at different locations on one graph.

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