Aviagen

Hatchery TIPS 09

# 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.

**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.**

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

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

**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.**

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.



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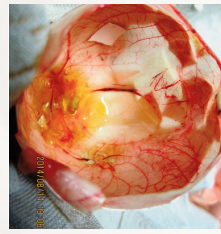
Hatchery TIPS 10

# 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.

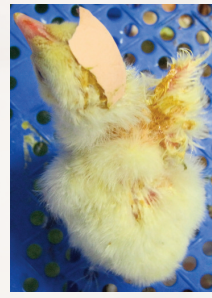
During the early stages of embryonic growth, the chorio-allantoic membrane (CAM) forms to enclose the albumen. This is the source of the network of blood vessels seen on the inside of the egg shell in hatch debris. If turning is inadequate for any reason, the CAM will not form properly, and short-circuits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



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

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.



**A chick with residual albumen on the down.**

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.



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Hatchery TIPS 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 [$Mg(NO_3)_2.6H_2O$] 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 multistage machines.

| 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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Hatchery TIPS 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.

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



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Hatchery TIPS 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%.
- 85m$^3$ fresh air per hour per 1000 chicks – the $CO_2$ level in the room should not go over 2000ppm.


High CO2 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.

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



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Hatchery TIPS 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.

Fig. 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

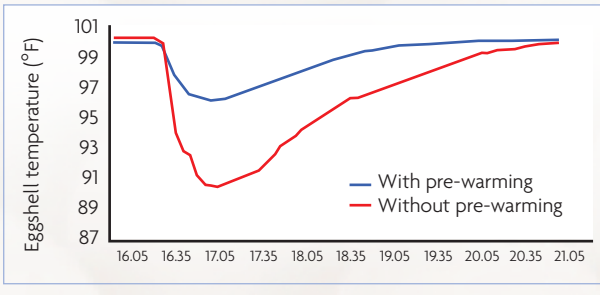
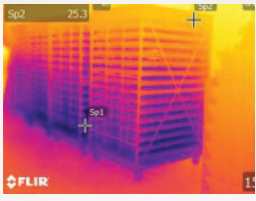



**Fig. 1. Eggshell temperature changes in part-incubated eggs immediately after more eggs are set either from the cold store or after pre-warming.**

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, left, shows uneven eggshell temperatures in trolleys after pre-warming without forced air circulation.



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Hatchery TIPS 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.

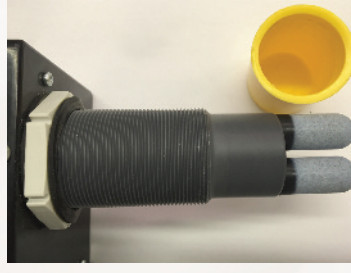
The first step is to make sure that the $CO_2$ sensors are all reading correctly. Prolonged exposure to high humidity levels during sealed incubation, and to chick fluff and humidity during hatching or even washing water can all affect the sensor or sensor protection cap leading to inaccurate readings.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



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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Hatchery TIPS 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.

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



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Hatchery TIPS 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?”

*A fumigation cabinet.*

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.



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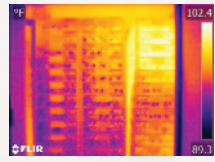
Hatchery TIPS 18

# 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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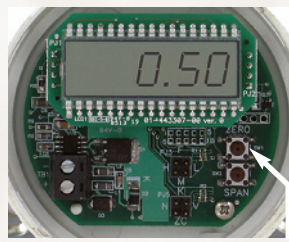
# ZERO CALIBRATION OF PRESSURE SENSORS

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 and below). 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.




Zero switch.


Menu driven zero calibration.

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.



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