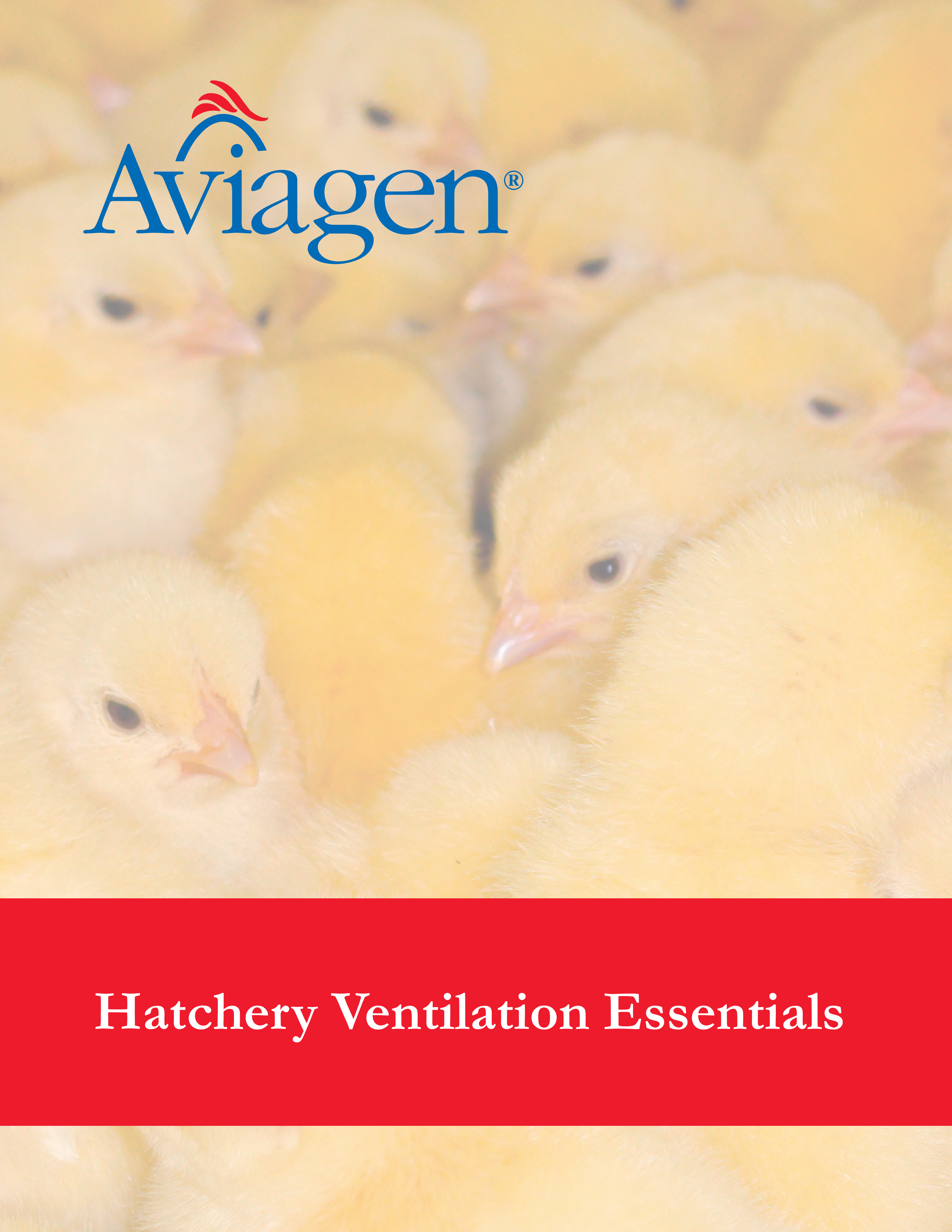

Aviagen®

Hatchery Ventilation Essentials

Hatchery Ventilation Essentials

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At the end of November 2007, he left Rainbow Farms and has since worked as a consultant, totally independent of any equipment company. Among other customers, Mr. Green consults for Aviagen in their business regions of Asia, Middle East and Africa, and Eastern Europe. His services include designing poultry house ventilation systems, asisting with housing upgrades, specifying ventilation equipment, trouble shooting ventilation related production problems, training, hatchery ventilation trouble shooting, design, and training.

Hatchery Ventilation Essentials

Why Do We Ventilate Hatcheries?

The eggs in incubators contain living, developing embryos. For them to achieve optimal development, chick quality, and hatchability, they need the correct temperature, humidity, and Carbon Dioxide (CO_2) to Oxygen balance. This will only happen if they are in rooms that are correctly ventilated.

The purpose of ventilating hatchery rooms is to provide the most consistent environment for the incubators to operate in so that the embryo development is optimized. An incubator should never have to do more than fine tune the condition of the air entering the room. In addition, ambient conditions can vary greatly, not only from one country to another, but from one season to another. As incubator manufacturers cannot custom make incubators for each region of the world, emphasis must be placed on making sure that the hatchery rooms are ventilated effectively.

The hatchery ventilation system must satisfy the assumptions made by the incubator manufacturers so that the incubator can operate in the way it was designed to. In order to design a machine that operates effectively and efficiently, and is cost effective to build and operate, certain assumptions are made by the manufacturers about the temperature and relative humidity (RH) range of the air entering the machine. This allows them to determine what the heating and cooling capacity of a machine should be in order to control the internal environment (temperature and RH). This information then becomes the manufacturers' specifications for a certain incubator which usually include recommendations for variables such as:

- Incubator air requirements per 1000 eggs set.
- Minimum room air changes per 1000 eggs.
- Supply air temperature and humidity.
- Room air pressure.
- Exhaust plenum air pressure.

The important aspects of ventilating each room are therefore air volume supply, room pressure, air temperature, and relative humidity.

Common Hatchery Ventilation Problems

There are a number of factors that may create ventilation problems in a hatchery:

- **Education**: Without a proper understanding of how to ventilate a hatchery, and what is trying to be achieved, mistakes will be made when setting-up the ventilation parameters.
- **Insufficient air volume supplied by the air handling unit**: This may be as a result of the original design specification being incorrect.
- **Insufficient fresh air supplied to the room**: In addition to the above, this may also be as a result of additional incubators being added to a room without the capacity of the air handling unit being increased.
- **Lack of preventative maintenance**: Another common cause of insufficient air volume supply to a room is a lack of maintenance. As fan belts and pulley's wear and radiators become more blocked, the supply volume of the air handling unit will be reduced.
- **Insufficient heating and cooling capacity**: This may be as a result of two factors - either the air handling unit has not been correctly designed/specified, or there is a lack of proper maintenance so that the unit is no longer operating as it should.
- **No monitoring equipment**: Monitoring room temperature, relative humidity, and pressure is important for ensuring adequate hatchery ventilation.
- **Improper calibration of the controls**: It is important that the control systems that monitor and regulate the temperature, relative humidity, and pressure are routinely calibrated. Without regular calibration there is no way of knowing the true conditions within a room.

The Room – The Starting Point

The starting point to ventilating a hatchery room successfully is the condition of the room itself. The room should be as air tight as possible. The better the room you are trying to ventilate can be sealed, the more control there will be over how and where the air enters and leaves the room. If the room has gaps or cracks, then air leakage will occur. If the room has too much air leakage, conditioned air from the air handling unit supplied into the room may be lost through gaps or cracks in the walls or the roof instead of finding its way into the incubator. It is more difficult to create positive pressure in a room with air leakage. The positive pressures used in hatcheries are small and even the smallest amount of air leakage from a room may make it difficult to maintain the correct operating pressure.

Typical areas of air leakage are:

- The seals of entrance doors and any other doors within the room.
- The roof - often roofs are constructed from multiple panels, each edge of such a roof is a potential leakage point and should be sealed.
- The area where the walls meet with the roof.

In older hatcheries there are often "over pressure" louvers located above the incubators to allow excess air to escape into the roof cavity. When trying to pressure control rooms with modern control systems (such as those described below) these over pressure louvers should be blocked in order to help with achieving room pressure.

Insulation is another very important aspect of successfully ventilating a room. In the winter months it is important to keep the warmth inside the room, and in the summer months it is important to keep the heat out of the room. This is more difficult to achieve if the room is not suitably insulated.

Room Air Volume Requirements

There are a number of different points to consider when determining the air requirements for a room. These are:

- The number of eggs in the room.
- The number of chicks in the room.
- The incubator manufacturers recommendations.
- The type of air handling unit to be used (chilled water [air conditioned] or evaporative cooled).
- The type of pressure control to be used.

A guideline for the air volume requirement per room is given later on in this article.

Air Handling Unit

In order to determine the heating and cooling capacity required by the air handling unit so it can provide the desired room conditions, it is essential to know:

- The total volume of fresh air to be delivered.
- Accurate data about the hottest and coldest times of the year.
- The desired room temperature range.

There are always certain assumptions made when anything is being designed. In the case of an air handling unit, one of those assumptions will be the minimum and maximum outside conditions that the cooling and heating can deal with. The higher and lower the actual/realistic outside temperature used in the design of the air handling unit, the more expensive the unit will be. Companies therefore often make an assumption about the "average" minimum and maximum temperatures for a particular area and design the air handling unit using these parameters. As a result, if the unit has to operate in conditions which exceed the ambient "design minimum and maximum" the room cannot maintain the desired temperature.

As such, it is a good idea prior to ordering an air handling unit, to ask the supplier at what minimum and maximum ambient temperatures the unit will be able to provide the desired room temperatures.

In hot, dry climates, a more cost effective option than a chilled water air handling unit is an evaporative cooled unit. Here cooling takes place through the use of cooling pads located within the air handling unit.

With evaporative cooling, care should be taken when selecting the control unit that will operate the cooling pumps. Allowing too much water to flow onto the pads too quickly can result in large fluctuations in room temperature. The drier the ambient climate, the greater the potential temperature fluctuations. To gain better control over the rate of cooling, it may be necessary to pulse/cycle the pumps in order to limit the amount of water flowing onto the pads.

The supply of fresh air must be evenly distributed throughout the room. Ideally this should be achieved via various supply points from a ducting system entering through the roof. If this is not possible and the supply is from a single point in the room, then a distribution sock/tube within the room should be used to help distribute the air evenly.

It is recommended that the design of air handling unit systems and ducting be done by a reputable company. Trying to save money and design your own air handling unit or ducting system can cost more than getting it done properly in the first place.

Humidification

Maintaining a certain level of relative humidity in a room is an important part of the ventilation system. In order to design a humidification system, the following information is required:

- The total volume of fresh air to be humidified.
- The lowest ambient relative humidity level during the year.
- The required room relative humidity.

By knowing this information, the amount of water that needs to be added to the air to reach the required relative humidity can be determined.

Steam humidification is probably the better means of humidifying, however, it is expensive with high electrical running costs.

Most often, humidification is done within the room using a high pressure spray system. With such a system, remember that there will be a certain level of evaporative cooling that will take place in the room each time the spray humidification system runs.

Pressure Control

As part of the ventilation of a hatchery, rooms are often pressure controlled. The purpose of pressure controlling a room is to assist, but not to force excess amounts of, air into the incubator. If a room has a positive pressure, it is an indication that after all the incubators in the room have taken the air they require there is still a surplus of supply air in the room.

If the room pressure is negative, it can be seen as an indication that the air supply is insufficient for the demand of the incubators within the room. As a result there will be “competition” between the incubators for the air and the incubators will not be getting the volume of air that they require.

In both setter and hatcher rooms, the pressure is usually set to a slight positive pressure (2.5 Pa/0.01 “WC). This will ensure that there is an adequate supply of air for the machines, without forcing air into the machine and disrupting the intended operation of the machine.

Units Of Pressure

Hatchery pressures are most often measured in either Pascals (Pa) or Inches of Water Column (“WC). The table below shows the conversion.

Table 1: Conversion table for hatchery pressure.

Pascals (Pa)	Inches of Water Column (“WC)
2.5	0.01
5.0	0.02
7.5	0.03
10.0	0.04

Measuring Room Pressure

Hatchery room pressures are preferably measured relative to the outside/ambient air pressure. In order to ventilate/draw air into a room, the pressure within that room must be slightly positive compared to whatever the ambient/outside pressure is. So, if the pressure in a room is +5 Pa, then it means that the room pressure is 5 Pa (0.02 “WC) higher in the room than the current ambient pressure at that location.

There are a number of pressure meters available on the market that are suitable for use in a hatchery.

Figure 1: Two examples of pressure meters. A floating ball type meter is on the left and a dial type meter is on the right.

All pressure meters should have 2 ports/terminals - one for positive pressure and one for negative pressure.

For further guidance on measuring room pressures, refer to **How To Measure Room Static Air Pressure in the Hatchery.**

Methods Of Pressure Controlling Rooms

There are a number of effective ways of pressure controlling rooms. Some of these methods are described below.

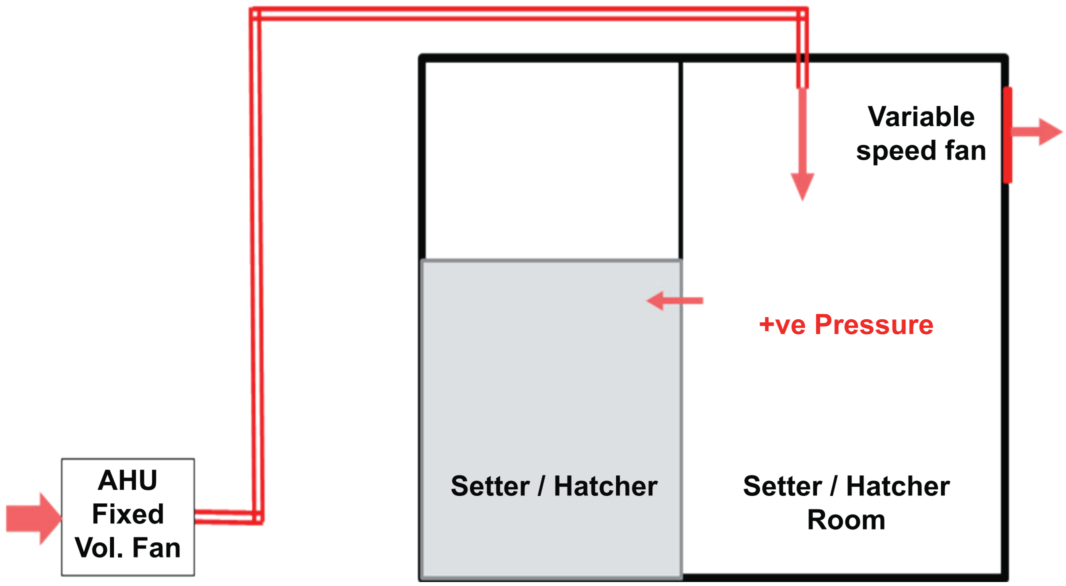
Fixed Volume Air Supply

In this system, the air supply into a room is from a fan with a fixed or constant speed. One method of controlling the pressure in a room with this sort of air supply system is through the use of a variable speed exhaust fan. The variable speed fan is regulated by a pressure controller that controls the speed of the fan in order to maintain the pressure in the room at the desired level.

The variable speed fan either "dumps" the excess room air through a wall to the outside of the hatchery or into the roof cavity.

This is a wasteful method of controlling room pressure because the excess air that gets dumped has already been conditioned. This method may be used in both setter and hatcher rooms and a typical layout is shown below.

Figure 2: Typical layout of a fixed volume air supply room.



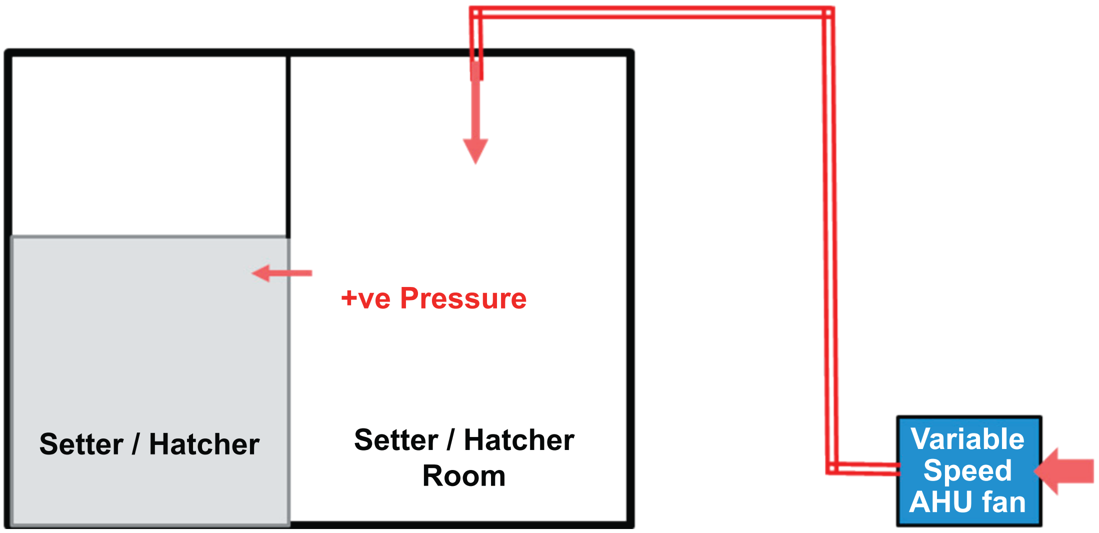
It is important for the capacity of the variable speed fan to be correctly determined during design. A typical fan configuration used for this application is shown below. The fan should have shutters on the outside and a weather hood/cowl.

Figure 3: Typical variable speed fan.

Variable Speed Air Handling Unit
In this system, the fan motor of the air supply to the room is variable speed and is linked to a pressure controller. The air supply fan will speed up and slow down to maintain and control the pressure of the room.

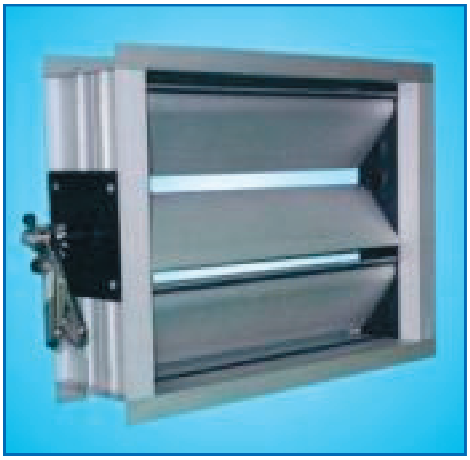
This is a far more energy efficient system than the fixed volume air supply system because only the air that is required for the incubators in the room will be conditioned (heated, cooled, humidified). This system may be used in setter and hatcher rooms (**Figure 4**).

Figure 4: Typical layout of a variable speed air unit.



Fixed Volume Air Supply with Return Air
In this system, the supply air fan operates at a fixed speed, supplying a fixed volume of air to the room, but there is a return air duct allowing air to be drawn from the room back to the air handling unit. The return air duct is fitted with a motorized damper (**Figure 5**). The motorized damper is connected to a pressure controller that regulates the damper position to control the amount of air that is allowed to return to the air handling unit. In this way the pressure is controlled within the room.

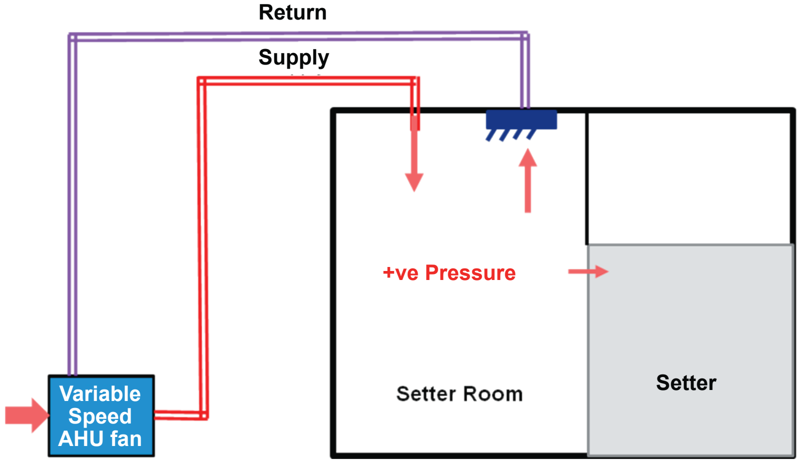
Figure 5: Example of a motorized return air damper.



This is an energy efficient method of pressure controlling the room since any conditioned air that does not enter an incubator in the room is returned to the air handling unit. A typical layout is shown in **Figure 6**.

This form of pressure control is best suited to setter rooms. It is not suited to any rooms where there may be fluff present, such as the hatcher or processing rooms, as the fluff may be drawn into the return air system.

Figure 6: Typical layout of a fixed volume air supply with return air unit.



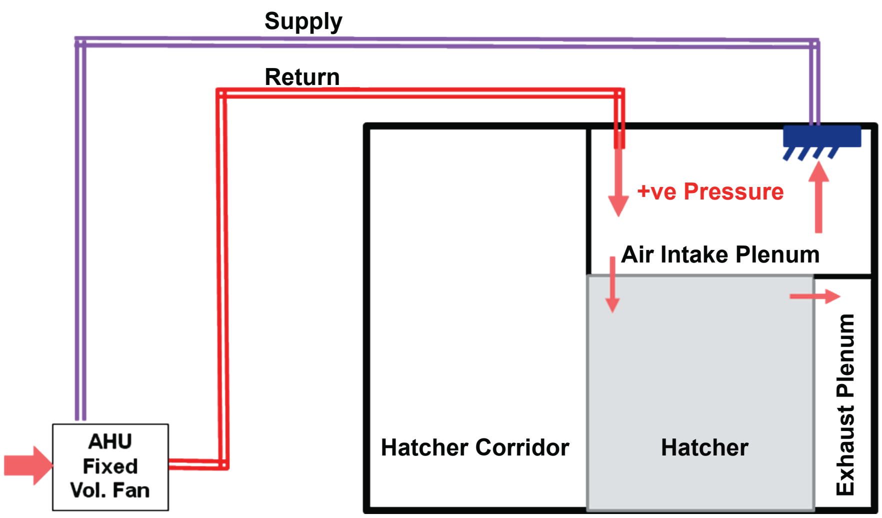
Fixed Volume Air Handling Unit With Return Air – Hatchers

In hatcher rooms, there is often concern over cross-contamination or fluff getting into the air handling unit if air is returned to the air handling unit from the room. A solution is to build a supply air plenum above the hatchers, assuming that the air intake is on top of the machine (**Figure 7**). With the supply in a closed plenum above the hatcher, there is little possibility of fluff entering the return air system, or of the air being contaminated before being returned to the air handling unit.

A motorized damper can be installed on the return air duct from inside the supply air plenum. The motorized damper must be connected to a pressure controller.

Another benefit to this type of configuration is that when the doors to the hatcher passage are open, it does not influence the pressure control of the supply air chamber.

Figure 7: Typical layout of fixed volume air handling unit with air return for hatchers.



Common Room Pressure Control Problems

There are a number of problems that are common to many pressure control installations.

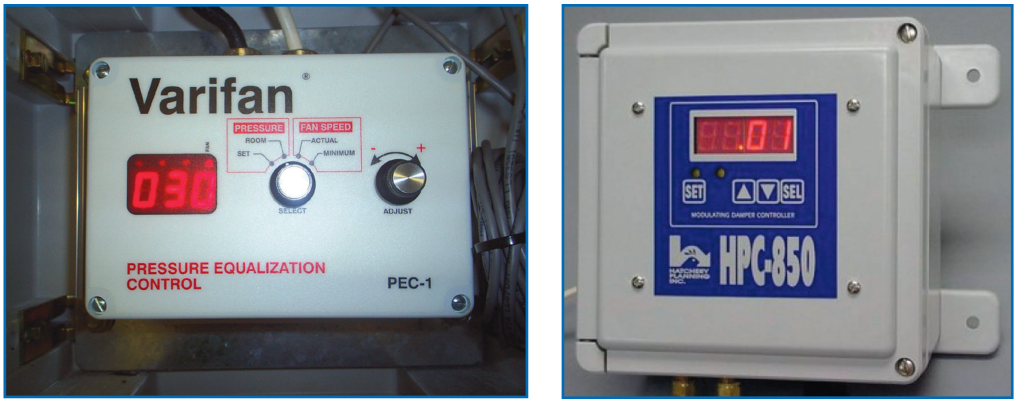
- ***Many hatcheries do not have instruments to measure pressure.***
  Almost every room of a hatchery will have a thermometer to measure room temperature, and most will also be able to measure humidity. Room pressure and air supply is important to the correct ventilation of a hatchery yet many hatcheries have no way of measuring it.
- ***Fixed volume air supply with "over pressure" louvers.***
  The "over pressure" louvers are usually installed in the wall above the setters or hatchers. The q purpose of these louvers is to allow surplus supply air to escape into the roof cavity area so that the room is not over-pressurized. In doing so, the louver often prevents the room from creating the required positive pressure because in effect, it is actually an air leakage in the room. However, this system can be used fairly effectively in setter rooms with many incubators, and in rooms with multi-stage incubators
- ***Insufficient air handling unit capacity.***
  If the air handling unit is not able to supply the correct volume of air for a given room, then it will not be possible to successfully pressure control the room.
- ***Poorly sealed room.***
  Even if the air handling unit is capable of supplying the theoretically correct volume of air, if the room is not sealed well enough, it may not be possible to generate the desired positive pressure in a room.
- ***Extraction fans.***
  Large capacity extraction fans running in any part of the hatchery can, and most probably will, have an effect on the pressure control of the entire hatchery. Every fan is designed to move a certain volume of air. If it is operating somewhere in a hatchery, it will draw air from wherever possible in order to move the volume of air it was designed to move. If this means that it must suck air through poor door seals, cracks, and gaps, then this is what will happen. As a result, it can quite easily "rob" air from other rooms around the hatchery, thus impacting the pressure control of rooms. If there are large volume extraction fans in parts of the hatchery (such as in the take-off and chick holding area), then the questions, "*Where are these fans going to get their air from*, and *is that particular supply of air sufficient*", should always be asked. If not, these fans are quite capable of "robbing" air from rooms on the opposite side of the hatchery.

Pressure Controllers

If rooms are going to be pressure controlled, it is recommended to use a pressure controller that has been specifically designed for hatchery use (**Figure 8**). Incubator companies understand the requirements of a hatchery pressure controller, and as such their products, are better suited to creating the uniform conditions required.

Cheaper, non-specific pressure controllers are not able to maintain the uniform low pressure required in a hatchery. This often results in continuously fluctuating pressures and non-uniform ventilation as the room cycles from high to low pressure.

Figure 8: Two examples of hatchery pressure controllers.

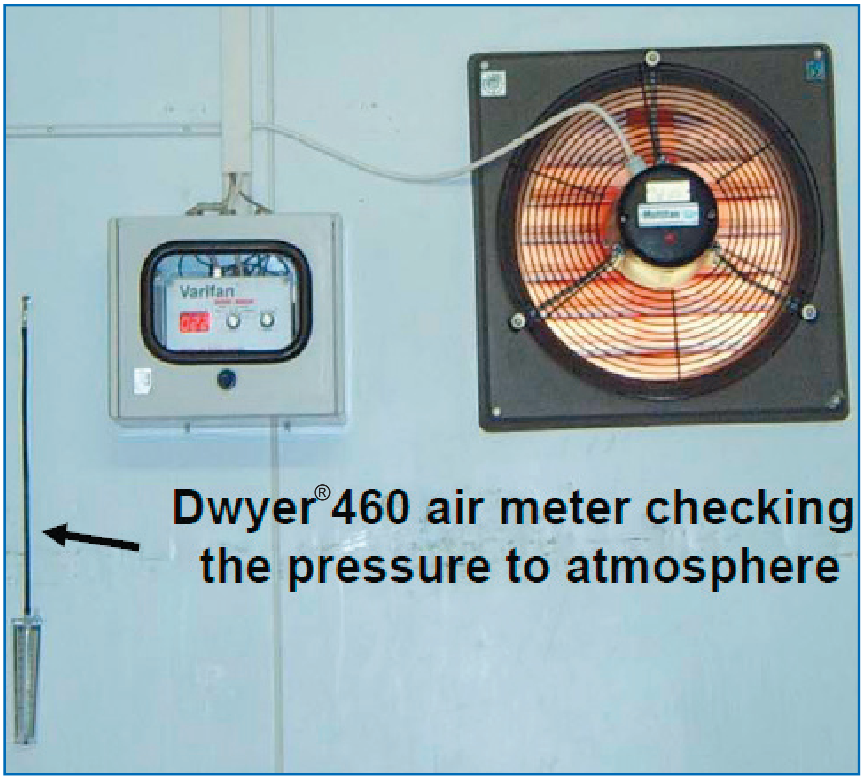


Pressure controllers should be calibrated at least every 2-3 weeks.

The first test that should be done is to remove both the positive and negative tube from the pressure sensor. When this is done, there will be no pressure differential across the pressure meter and the reading should be zero.

Another calibration test is to use a mobile/handheld pressure meter to verify the actual reading of the pressure controller. In **Figure 9**, a handheld Dwyer® 460 Air Meter (on the left) is being used to verify the reading on the Varifan® controller while the variable speed fan controls the room pressure.

Figure 9: A handheld Dwyer® 460 air meter.



Potential Incubator Exhaust Problems

Ideally, the exhaust side of an incubator should be controlled at the pressure as specified by the incubator manufacturer. If no such specification exists, then it is usually safe to try to control the exhaust at 0 Pa (0 “WC). In other words, the pressure in the exhaust plenum should be the same as ambient pressure.
If the exhaust side pressure becomes too positive relative to ambient pressure, it can prevent the incubator from exhausting freely and may reduce the air flow through the machine. This could cause problems for the operation of the incubator and may result in hot spots in the machine. It could also result in higher than normal temperature, humidity, and CO_2 levels. Chick quality may be affected.

If the pressure on the exhaust side of the incubator becomes too negative relative to ambient pressure, it may result in air being “pulled” through the machine. This could result in problems with temperature control, and lower than normal humidity and CO_2. This can also disrupt the air distribution inside the machine resulting in “dead spots” within the incubator. Ultimately, chick quality may be affected.

Advantages of Pressure Controlled Exhaust Plenums

The purpose of a pressure controlled exhaust plenum is to maintain a constant pressure in the plenum and prevent either a positive or negative pressure from developing by reacting as the machine output varies.

A controlled pressure exhaust plenum should allow the incubator to exhaust how it was designed to exhaust, and as such, allow the incubator to ventilate how it was designed.

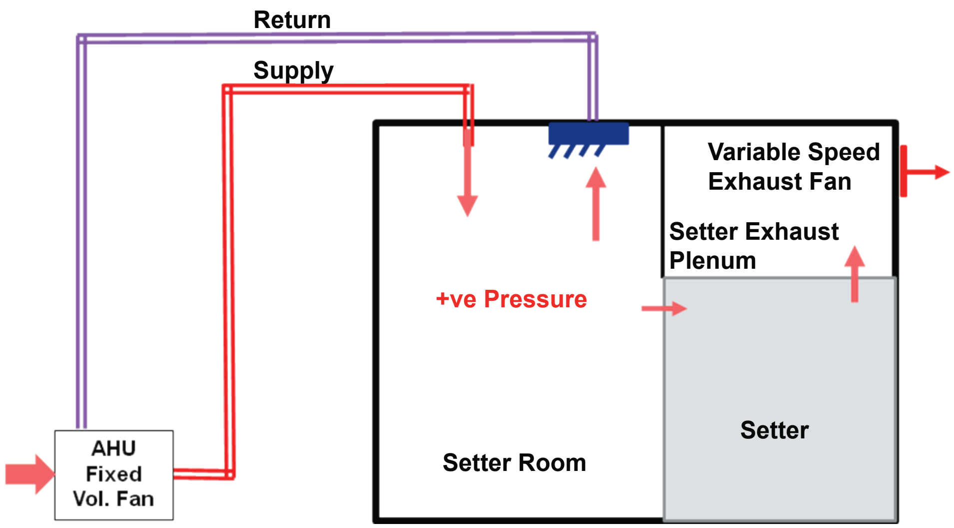
An exhaust plenum eliminates the traditional type exhaust ducting that required monitoring and balancing.

On hatchers, the use of an exhaust plenum (fluff chamber) means that there is little or no exhaust ducting to be cleaned. It also reduces the amount of fluff that is exhausted to the outside of the building.

Increasing the negative pressure (within reason) in the hatcher exhaust plenum is another way of increasing the air flow through the hatcher after the chicks have hatched. However, if the negative pressure is increased too much, dead/hot spots may be created and chick quality will be affected. Chick quality should be monitored and analyzed carefully to make sure negative pressure remains acceptable.

Exhaust Pressure Control – Setters
If an exhaust plenum is created above the setters, the pressure can be controlled through the use of a variable speed fan and a suitable pressure controller (**Figure 10**). In this case, the pressure in the room and the plenum should be controlled separately.

Figure 10: Typical layout of an exhaust pressure control system.



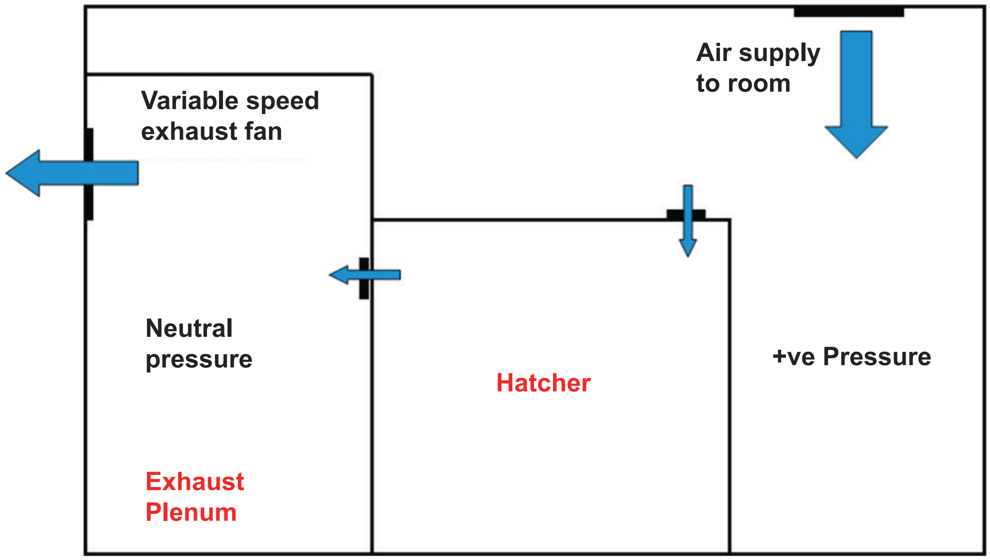
Hatcher Exhaust Plenums

A hatcher exhaust plenum is simply a well-sealed room located behind the hatchers into which air from the hatchers is exhausted (**Figure 11**). The plenum is fitted with a variable speed fan that is regulated by a pressure controller. The pressure in the plenum is usually controlled at 0 Pa (0 "WC) relative to outside. The benefits of the exhaust plenum are:

- It allows the hatcher to exhaust freely without the possibility of a positive or negative pressure at the exhaust.
- It eliminates the need for any form of exhaust ducting that would need to be cleaned after each hatch.
- It greatly reduces the amount of fluff that is exhausted outside the hatchery.

The variable speed exhaust fan should be installed at least 1 m (3.3 ft) away from the nearest hatcher exhaust. The fan should preferably be installed above the height of the exhausts. As with every other variable extraction fan in the hatchery, the plenum variable fan must be fitted with a louver and cowl/ weather hood on the outside.

Figure 11: A typical configuration of the hatcher and plenum.



In the above situation, the hatcher exhausts through the rear of the machine directly into the exhaust plenum.

In the case where the hatcher exhausts through the top of the machine, it is preferable to install a gentle bend leading from the exhaust of the hatcher into the plenum, rather than a sharp elbow (see **Figures 12** and **13**).

Figure 12: In this example, the top exhaust is in the form of a gentle bend. This allows for easier air flow from the hatcher.

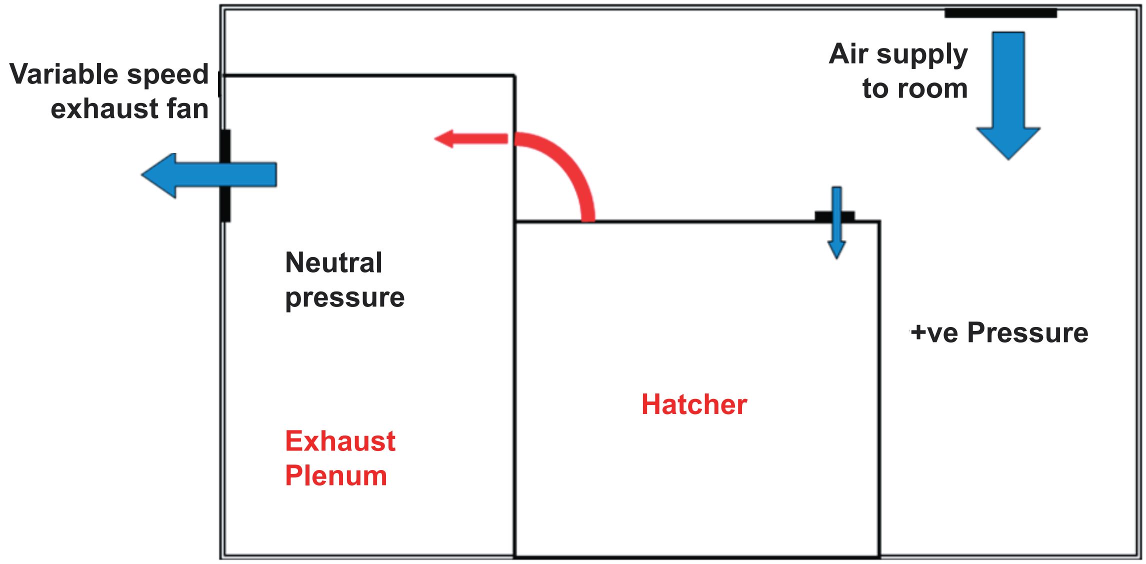
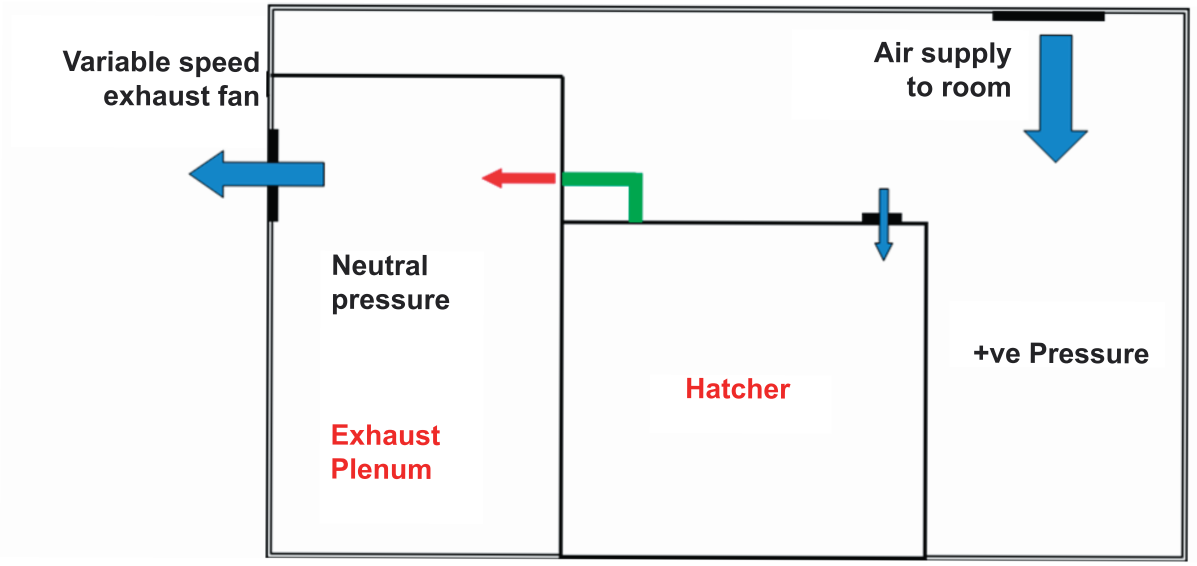
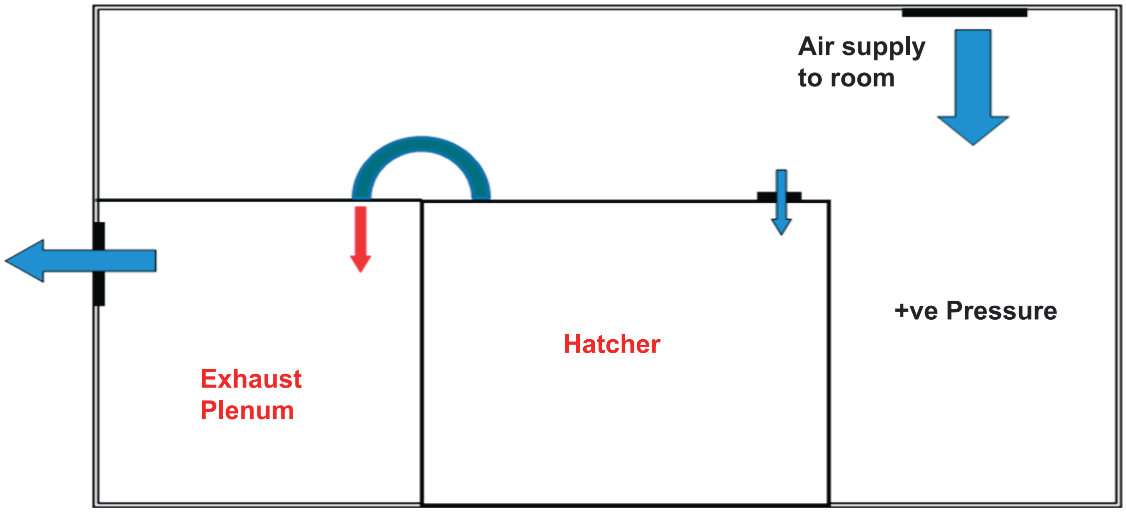


Figure 13: In this example, a sharp elbow is used as the top exit exhaust of the hatcher into the exhaust plenum. The sharp 90° change in direction can cause back pressure on the exhaust of the hatcher.



The configuration in **Figure 14** should also be avoided. It may result in back pressure on the exhaust of the hatcher since it is trying to make the hot air from the hatcher go up and then down into the plenum. This works against the natural tendency of hot air to always try to go upward.

Figure 14: The diagram below shows another configuration that should be avoided where possible. Here the hatcher exhausts through the top of the machine and an inverted "U" is used to direct the air into the plenum.



Hatcher Room Location

In new hatcheries, it is preferable to have the hatcher room on an outer wall of the building. This allows for the easy installation of exhaust plenums in the room that air can exhaust through an external wall to the outside of the hatchery.

This kind of installation (as depicted in **Figures 11-14**), then allow for the use of a flat wall mounted variable fan in the plenum. This kind of installation makes it easy to access the fan for maintenance, and more importantly, cleaning purposes. It is easy to access both sides of the fan and it can be cleaned thoroughly after each hatch.

Where hatcher rooms are located centrally within a hatchery, then the only way to ventilate the exhaust plenum is either via a chimney fan going up through the top of the roof to the outside, or via a duct system to the nearest external wall. Either of these options result in problems with properly cleaning the fan and/or ducting after each hatch. In the case of chimney fans, cleaning above the exhaust fan is almost impossible.

Hatchery Room Guidelines

The following provides a general guideline for the various rooms of the hatchery. As air will flow from a positive to a negative pressure, clean areas of the hatchery should have a positive pressure and dirty areas a negative pressure.

Egg Receiving and Holding

Temperature	18-20ºC (64-68ºF)
Humidity	70-75%
Air Exchange	3.4 m^3/hr per 1000 eggs (2.0 cfm per 1000 eggs)
Airflow	Good distribution
Pressure	Neutral – 0 Pa/"WC
Exhaust	To atmosphere

Comments:

- A small amount of fresh air should be supplied based on the number of eggs in the room.
- Many egg holding rooms do not have a fresh air supply and rely only on the opening and closing of the doors to create an air exchange.
- Because the temperature of the egg room is usually controlled at around 18°C (64°F), the introduction of fresh air can make it very difficult to maintain this temperature, especially in the summer months.
- Thus many egg storage rooms just make use of air conditioning units mounted within the egg room itself.
- These units simply recirculate air within the room, and in doing so, it is far easier to maintain a more consistent temperature.
- Needless to say, the egg holding room must be well insulated.
- Internal circulation fans located strategically throughout the room assist in distributing the temperature throughout the room.
- This helps to ensure good egg temperature uniformity throughout the room during storage.
- Fans should not blow directly onto the eggs.

Setter Room

Temperature	24ºC (75ºF)
Humidity	60%
Air Exchange	13.6 m^3/hr per 1000 eggs (8 cfm per 1000 eggs)
Airflow	Uniform throughout room
Pressure	+5 Pa (+0.02 "WC)
Exhaust	To atmosphere or neutral exhaust plenum

Comments:
When calculating the room air volume requirements of the setter room, the following must be taken into consideration:

- Are they single or multi-stage machines.
- If single stage, how many machine's dampers will be open and by how much at different egg ages.
- These factors can influence the actual air volume requirement since less air will be required if a certain percentage of setter dampers are closed or only partially open (single stage).

Hatcher Room

Temperature	24ºC (75ºF)
Humidity	55-60%
Air Exchange	25.5 m³/hr per 1000 eggs (15 cfm per 1000 eggs)
Airflow	Uniform throughout room
Pressure	+2.5 Pa (+0.01 ”WC)
Exhaust	The hatcher should exhaust to a neutral (0 Pa) exhaust plenum

Chick Holding Room

Temperature	24ºC (75ºF)
Humidity	65%
Air Exchange	85 m³/hr per 1000 chicks (50 cfm per 1000 chicks)
Airflow	Uniform throughout room and chick boxes (no drafts on chicks)
Pressure	Neutral to slightly negative
Exhaust	To atmosphere

Comments:

- The chick holding room can be thought to have two ventilation systems.
- The first system introduces air into the room, and the second system distributes the air.
- Because the chicks are in baskets or boxes, air distribution and movement in between the rows/stacks of boxes/baskets is critical.
- Although it is important to pay attention to the room temperature, it is even more crucial to observe the bird behavior and comfort levels within the baskets.
- When doing this, be sure to observe the comfort level of the chicks in the top, middle, and bottom baskets/boxes.
- Very often mobile circulation fans are used within the chick holding room to create air movement between the baskets/boxes.
- This air movement between the baskets/boxes is what helps to ventilate the baskets/boxes.
- In trying to create air movement between the baskets/boxes, it is important that the fans do not blow directly at or into the baskets/boxes as this will stress the chicks.

Wash Room

Pressure	Slightly more negative than other rooms
Exhaust	To atmosphere

Clean Equipment Holding Room

Pressure	More positive than other rooms
Exhaust	To atmosphere

How to Calculate Air Requirements

Units Of Air Volume

The two most common units of air volume used are:

- cubic meters per hour – m^3/hr (metric).
- cubic feet per minute – cfm (imperial).
- 1 m^3/hr = 0.59 cfm.
- 1 cfm = 1.7 m^3/hr.

Why Do we Need To Know The Air Requirements?

When designing or upgrading a hatchery it is important to know the total air requirement of each room.

This will help us to determine not only the capacity of the air handling unit required, but also how much heating, cooling, and humidification is needed to condition the air.

Calculation Criteria

Calculating the air requirements for a room may be based on one or a combination of the following criteria:

- Incubator manufacturer's specifications.
- The total number of eggs in the room.
- The total number of chicks in the room.
- The type of air handling unit being used (chilled water or evaporative).
- The type of pressure control used in the room.

Note: *The calculations below are intended only as a guideline to calculating the air volume required in various rooms.*

Incubator Manufacturers Specifications

- The incubator manufacturer should be able to provide a specification that recommends the volume of air to be supplied into the room for each setter/hatcher in the room.
- For example:
  - 400 m^3/hr (236 cfm) per setter.
  - Bear in mind that this air volume will depend on the number of eggs in that particular model of setter.
- ***Calculation:***
  - ***Room air volume required = air volume per incubator x number of incubators in the room.***
- In the case of single stage setter room requirements, a more realistic estimation may be calculated by determining the real "maximum demand scenario".
- This entails estimating how many setters will be at what stage of incubation and damper opening to get a more accurate/realistic idea of the air volume required.
- Example:
  - If there are 12 setters of the type specified above, then,
  - Maximum air volume required = 400 m^3/hr x 12 setters = 4,800 m^3/hr, or,
  - Maximum air volume required = 236 cfm x 12 setters = 2,832 cfm.

Total Number Of Eggs In The Room

- An example of such a specification would be:
  - 13.6 m^3/hr per 1,000 eggs (8 cfm per 1,000 eggs).
- ***Calculation:***
  - ***Air volume required = (maximum number of eggs in the room) x (air volume / 1,000 eggs) ÷ 1,000.***

- Example:
  - ◦ If there are 8 setters with 30,200 eggs per setter, then,
  - ◦ Air volume required = (8 x 30,200) x (13.6 m^3/hr/1,000 eggs) ÷ 1,000 = 3,286 m^3/hr, or,
  - ◦ Air volume required = (8 x 30,200) x (8 cfm/1,000 eggs) ÷ 1,000 = 1,933 cfm.

Total Number Of Chicks in The Room

- An example of such a specification would be:
  - ◦ 85 m^3/hr (50 cfm) per 1,000 chicks
- ***Calculation:***
  - ◦ ***Air volume required = (maximum number of chicks in the room) x (air volume / 1000 chicks ÷ 1000.***
- Example:
  - ◦ A chick holding room with a maximum capacity of 60 000 chicks.
  - ◦ Air volume required = (60 000 chicks) x (85 m^3/hr/1000) ÷ 1000 = 5 100 m^3/hr, or,
  - ◦ Air volume required = (60 000 chicks) x (50 cfm/1000) ÷ 1000 = 3 000 cfm.

Estimating The Actual Air Supply To A Room

In an existing room, the actual existing air supply to the room may be estimated as follows:

- Measure the dimensions (length x width) of each air supply entering the room.
- Calculate the cross sectional area of each supply.
  - ◦ Cross section area = length x width
  - ◦ Where:
    - - Length is measured in mm or inches.
    - - Width is measured in mm or inches.
    - - Cross section area = mm^2 or in^2.
- Measure the air speed through each duct as it enters the room.
- The air speed is usually measured in:
  - ◦ Meters per second (m/s), or,
  - ◦ Feet per minute (fpm).
- Calculate the volume of air entering through each duct as follows:
- Metric
  - ◦ ***Air volume (m^3/hr) = cross section area (mm^2) x air speed (m/s) x 0.0036.***
  - ◦ Where 0.0036 converts mm^2 to m^2 and m/s to m/hr.
- Imperial
  - ◦ ***Air volume (cfm) = cross section area (in^2) x air speed (fpm) ÷ 144.***
  - ◦ Where 144 is a conversion from in^2 to ft^2.
- Be aware that this is only an approximation of the air volume entering the room.
- To ensure that this air is available to the incubators in the room, it is important that the room is well sealed.
- Example:
  - ◦ There is one inlet duct entering a room. Its dimension is 300 mm x 300 mm (11.8” x 11.8”).
  - ◦ The air speed entering through the inlet is approximately 4 m/s (787 fpm).
  - ◦ Calculation:
    - - Air volume = (300 mm x 300 mm) x (4 m/s) x 0.0036 = 1,296 m^3/hr, or,
    - - Air volume = (11.8” x 11.8”) x (787 fpm) ÷ 144 = 761 cfm.

Air Volume Guidelines

The following may be used as a guideline:

- Setter room: 13.6 m^3/hr per 1,000 eggs (8 cfm per 1,000 eggs).
- Hatcher room: 25.5 m^3/hr per 1,000 eggs (15 cfm per 1,000 eggs).
- Chick holding: 85 m^3/hr per 1,000 chicks (50 cfm per 1,000 chicks).

Checking By Measuring Room Pressure

- A simple way to check if the current air supply into a setter/hatcher room is adequate is to measure the room pressure.
- Remember that the room pressure must always be measured relative to the ambient/outside pressure.
- If the room pressure is negative, then there may be 2 possible reasons:
  - The air supply to the room may be insufficient, or,
  - It may actually be adequate but the room may have too many air leakage points such as poor door seals, gaps/cracks in the roof or walls, or unnecessary extraction fans or over-pressure louvres.
- If the room pressure is positive, then:
  - This is a good start, but does it meet the specification of the incubator manufacturer?
  - A general guideline for the setter/hatcher room pressures is:
    - Setter room : +5 Pa (+0.02 inches of water column).
    - Hatcher room : +3 Pa (+0.01 inches of water column).

NOTES

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