Understanding the essentials of ventilation: calculating air requirements

When designing or upgrading a hatchery it is important to know the total air requirement of each room. This will help 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/ evaporative).
- The type of pressure control used in the room.

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).
- 1m^3/hr = 0.59cfm.
- 1cfm = 1.7m^3/hr.

Manufacturer's 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 (236cfm) 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 = 400m^3/hr x 12 setters = 4,800m^3/hr, or,
  - Maximum air volume required = 236cfm x 12 setters = 2,832cfm.

Total number of eggs in the room

- An example of such a

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. **aviagen.com**

Egg receiving and holding

- 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

When calculating the 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).

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

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

specification would be:
• 13.6m³/hr per 1,000 eggs (8cfm 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 (13.6m³/hr/1,000 eggs) ÷ 1,000 = 3,286m³/hr, or,
  • Air volume required = (8 x 30,200) x (8cfm/1,000 eggs) ÷ 1,000 = 1,933cfm.

Total number of chicks in the room

- An example of such a specification would be:
  • 85m³/hr (50cfm) 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 (85m³/hr/1,000) ÷ 1,000 = 5,100m³/hr, or,
  • Air volume required = (60,000 chicks) x (50cfm/1,000) ÷ 1,000 = 3,000cfm.

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 = mm² or in².
- 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 (m³/hr) = cross section area (mm²) x air speed (m/s) x 0.0036.
  • Where 0.0036 converts mm² to m² and m/s to m/hr.
- Imperial
  • Air volume (cfm) = cross section area (in²) x air speed (fpm) ÷ 144.
  • Where 144 is a conversion from in² to ft².
- 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 300mm x 300mm (11.8" x 11.8").
  • The air speed entering through the inlet is approximately 4m/s (787 fpm).
  • Calculation:
  - Air volume = (300mm x 300mm) x (4m/s) x 0.0036 = 1,296m³/hr, or,
  - Air volume = (11.8" x 11.8") x (787fpm) ÷ 144 = 761cfm.

Air volume guidelines

The following may be used as a guideline:
- Setter room: 13.6m³/hr per 1,000 eggs (8cfm per 1,000 eggs).
- Hatcher room: 25.5m³/hr per 1,000 eggs (15cfm per 1,000 eggs).
- Chick holding: 85m³/hr per 1,000 chicks (50cfm per 1,000 eggs).

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 two 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). ■

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

Hatcher room

Temperature	24°C (75°F)
Humidity	55-60%
Air exchange	25.5m³/hr per 1000 eggs (15cfm 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

- 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.

Temperature	24°C (75°F)
Humidity	65%
Air exchange	85m³/hr per 1000 chicks (50cfm per 1000 chicks)
Airflow	Uniform throughout room and chick boxes (no draughts on chicks)
Pressure	Neutral to slightly negative
Exhaust	To atmosphere

- 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 behaviour 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