

MINIMUM VENTILATION; A MUST FOR GOOD BROILER RESULTS

It is very evident that minimum ventilation in broiler or parent stock chicks is the most misunderstood management concept encountered in most tropical and sub-tropical countries. Because average temperatures are high, it is assumed that only tunnel ventilation after 4 weeks of age is needed to control the temperature and get fresh air to the birds. The problem arises when 1, or several tunnel fans are used to control the temperature and get fresh air at bird level in the first 14 days of the life of the broilers. With this concept excess air speed over the chicks will result, causing a chill effect. Feed kcal will in this case be used for heat production and not for maximum growth rate.

Baby chicks in the first 2 weeks of the rearing should receive almost zero air speeds from the ventilation system. If only 1 fan ran from the tunnel ventilation system, the airspeeds would surpass easily 50 fpm, and that is 10 times as much as the chicks should feel. The results are inconsistent broiler results that most of the time do not get even close to the body weight (BW) and feed conversion (FC) standards of the breed.

Minimum ventilation can be done in several different ways and this article will give some options on how to implement the system from the simplest one to the complete automated concept. It is, however, important to realize that minimum transition and tunnel ventilation depends on good airtight houses with minimum leaks or false air entering the house. Be assured that this will need enough attention when upgrading existing older house facilities.

The 1st concept is an emergency method in which minimum ventilation is achieved by opening both side curtains of the house.

Photo 1.

The tunnel fans are used in this case because that is all there is in these houses and 1, 2 and up to 3 (maximum 4) tunnel fans could run (based on temperature). Both sidewall curtains are opened a very little bit so that outside air comes into the house with a certain speed based on the width of the house. In a 12 m (39.4 f) wide house the airspeed needs to be 900 fpm and this corresponds with a negative pressure of 0.05. We can start using 1 fan when the chicks are 1 day old on a timer and based on air quality and needed temperature, an increased number of fans is used.



However, this system has 3 disadvantages: The incoming air tends to drop off quickly towards the floor where the chicks are, it is labor intensive management, then based on the amount of fans the curtain opening needs to be adjusted to maintain the proper airspeed, and the curtains need to be very much in a horizontal line to get uniform air distribution over the length of the house.

The **2nd concept** can be used to upgrade the house ventilation system by continuing to use the tunnel fans. But now, instead of opening the side curtains, air inlets are built into both side upper walls to let air in. This concept can give us minimum as well as transition ventilation controlled by the tunnel fans.

Photo 2.



If the houses are 45 feet (13.7 m) or less in width, the inlet TJP 2155 model is used, opening at 0.055 static pressure. For houses more than 45 feet wide the TJP 2165 model is used, opening at 0.065 static pressure.

Calculation for the amount of inlets, example: A house is 40 feet wide, 500 feet long and on average 8.5 feet in height. The cross section is $40 \times 8.5 = 340 \text{ f}^2$. The maximum speed for tunnel is 500 fpm, so we need a ventilation capacity for $500 \times 340 = 170,000 \text{ cfms}$.

This means 8 fans of 21,250 cfm. In the first 2 weeks, a maximum of 2 fans will run or $2 \times 21,250 \text{ cfm} = 42,500 \text{ cfms}$. Each TJP 2155 air inlet will have a capacity of 1800 cfm. This means we will need to install $42,500 \div 1800 = 23.6$ or 24 inlets spaced over both sides of the lateral sides of the house or 12 per house side.

If transition ventilation is used from 14 to 28 days of age, instead of 2, up to 4 fans will be running and thus the double amount of inlets needed to be installed ($2 \times 20 = 40$ inlets or 20 on each side of the house). The inlets need to be staggered. For a 500 feet long house the first inlet on one side needs to be positioned at $500 \div (2 \times 20) = 12.5$ feet from one corner of the house and then position each other inlet at double the distance or $2 \times 12.5 \text{ f} = 25$ feet (7.6 m). Because we want them staggered, the other side of the house can start at $12.5 \div 2 = 6.25$ feet from the corner of the house and then at 25 feet from each other. Because all the air is coming from the TJP inlets the airspeed over the birds is calculated by dividing by 4 the tunnel airspeed calculation. Example: 10 days of age, 2 fans = $42,500 \text{ cfms} \div 340 \text{ f}^2$ (cross section) = $125 \text{ fpm} \div 4 = 31 \text{ fpm}$ over the chicks. With 4 fans running (20 days of age) the airspeed would be $4 \text{ fans} = 85,000 \text{ cfms} \div 340 \text{ f}^2 = 250 \text{ fpm} \div 4 = 62 \text{ fpm}$ over the chicks.

The **3rd concept** is a variation of the 2nd concept where installing only inlets for the first 14 days (10 inlets on each side) and then going to transition ventilation after 14 days by opening **part** of the air inlet curtain. This will increase the airspeed over the chicks but now instead of dividing by 4 we need to divide by 2.

The inlet curtains are opened enough to maintain the negative pressure over 0.055 so that the TJP 2155 inlets open. This will increase the airspeed over the birds but cuts it in half compared to using 100% the inlet curtains. This means that if 3 fans are running after 14 days of age and the airspeed would normally be $3 \times 21,250 = 63,750 \text{ cfms} \div 340 \text{ f}^2$ (cross section house) = $188 \text{ fpm} \div 2 = 94 \text{ fpm}$ over the birds (norm for 3d week is up to 100 fpm). With 4 fans running it would go up to $4 \times 21,250 = 85,000 \div 340 \div 2 = 125 \text{ fpm}$.



Photo 3: View from the doghouse through the air inlet curtain opening into the house.



Inlet curtain opening for tunnel ventilation or for use in combination with transition ventilation

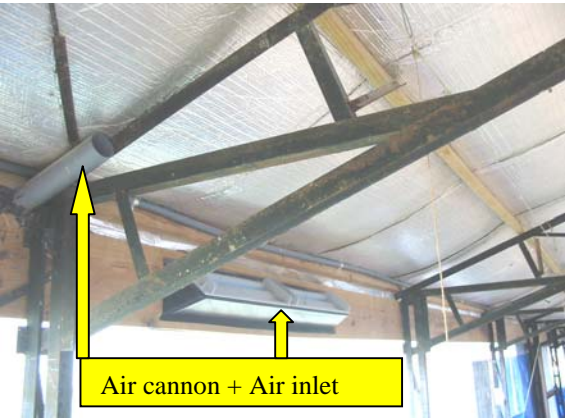
Photo 4. View of the air inlet curtain from the inside of the house. Observe that 4 fans are running at the end and this is the maximum opening allowed for proper house pressure. Opening of the inlet curtains can be relative small and proper airspeed again should be 900 fpm in a 40 f (12 m) wide house.

With this concept there is less investment in inlets but more attention should be paid to keep enough inlet curtain opening to maintain the pressure high enough in the house for the TJP units to open completely.

This 3rd concept is cheaper than concept 2 and 4 and ideal for lowland tropical areas where the temperatures do not drop below 20°C in the coolest part of the year.

The 4th-and most complete minimum ventilation concept operates with air cannons for primary air exchange and pressure regulated air inlets (TJP's) as secondary inlets. The fans in the sidewall, and not the tunnel fans, operate the secondary inlets. So instead of ventilating over the length, the ventilation is done over the width or cross section of the house. One lateral side will have 3, 36" fans and the other side the air cannons and the TJP inlets. This is the best system when we have cool temperatures in large part of the year in mountain areas in the tropics.

With the same house dimensions of 40 feet wide, 500 feet long and on average 8.5 feet in height and the same fan capacity as in concept # 2, the number of side fans will be the house volume (40 x 500 x 8.5 f) = 170,000 f³ ÷ 5 minute air exchange (maximum minimum ventilation) = 34,000 cfms ÷ 10,500 cfms (capacity of each 36" fan) = 3 fans needed. The amount of air cannons of 3 f (1m) in length and a diameter of 2.5 inch (6.3 cm) is calculated as: 500 f ÷ 10 = 50+8 air cannons in the 4 corners (2x4). 500÷50 = 10 feet distance each air cannon.



Air cannon + Air inlet

The amount of TJP 2155 air inlets are calculated as; 3 side fans x 10,500 cfm = 31,500 cfms – 7000 cfms for leakage – (58 x 37 cfms = 2146 cfms) = 22,354 cfms ÷ 1800 cfm (capacity of 1 TJP 2155) = 12.4 or 13 inlets. The first one is spaced at (500 ÷ (2x13)) = 19 feet from the corner of the house and all the others at double the distance (2x19=38 feet).

For transition ventilation from 14 to 28 days of age, you calculate that for cold climates 2 fans are needed, and for cooler tropical mountain climates 3 tunnel fans are needed. This transition ventilation is put in more and more to avoid also between 15 and 28 days of age too much airspeed over the birds. Additional inlets TJP 2165 (open at negative pressure of 0.065) are positioned in the same lateral side as the 3, 36" fans and part on the same side of the TJP 2155 inlets to make both sides even in numbers. These inlets of TJP 2165 will open only (together with TJP 2155 inlets) when the negative pressure comes above 0.065 and this happens when the tunnel fans enter in operation. For the tropical countries 3 tunnel fans are used with a capacity of 3 x 21,250 cfm (fan capacity) = 63,750 cfms – 23,000 (capacity of 2155 inlets for first 14 days = 40,750 cfms left over. The number of additional inlets for transition ventilation is thus 40,750 cfms ÷ 1800 = 23 inlets. Because the 2155 and 2165 have the same inlet capacity of 1800 cfms the amount of inlets needs to be positioned uniformly over both lateral sides.

This mean that on the opposite side of the side fans, for minimum ventilation, we have our 13 inlets and 23 more are needed to be installed for the transition ventilation divided over both sides, giving a total of 36 inlets. This means on each side we need $36 \div 2 = 18$ on 1 side and 18 inlets on the other side.

If we have already 13 inlets TJP 2155 on 1 side, we need to add $18-13 = 5$ TJP 2165 inlets. The distance of the 1st fan from the corner of the house will be $500 \text{ f} \div (2 \times 18) = 13.9 \text{ f}$ and then each other at $2 \times 13.9 \text{ f} = 27.8 \text{ feet}$. The 5 TJP 2165 inlets should be well distributed over the length with the TJP 2155 in between. Basically after the installation of 2 TJP 2155 inlets there is 1 TJP 2165 inlet, etc. On the other side we need to place 18 inlets TJP 2165 and staggered compared to the other side. The first one is positioned 5.2 feet from the corner and then at 27.8 f of each other.

Programming the solid-state controls for the 4th minimum and transition concept.

For the 1st week we need 90°F still air for the chicks. The 2 side wall fans will run on a cycle timer below 90°F set point and will run 1 out of 5 minutes or 1 minute on and 4 minutes off.

At 90°F the 2 side fans will run 100% of the time.

At 91°F the 3d fan will run also at 100% of the time.

At 93°F, 1 tunnel fan will start up and the side fans will stop operating. Because the capacity of 1 tunnel fan is less than the 3 side fans the secondary air inlets will continue to stay open. At 94°F the second tunnel fan will start up and the transition inlets will start to open up also as will be the case with tunnel fan number 3.

Up till 21-28 days of age depending on the temperature the first 3 tunnel fans operate.

When tunnel fan number 4 enters (normally after 28 days of age) the air inlet curtains will open and the transition and minimum ventilation inlets will close then the pressure will be less now (0.05).

Up to 2 weeks the temperature will be monitored based on dry bulb temperature or simply based on the thermometer. After 14 days of age it will be the effective temperature taking into account also the relative humidity and the airspeed through the house.

This means that the set point for the controls will be the same in the first 2 weeks as the ideal temperature for the chicks based on dry bulb thermometer but after that it will need to be calculated based on the airspeed through the house that the birds will feel. Then the effective temperature and RH chart needs to be used.

A simple rule of thumb on what the “feel” temperature should be for the chicks being it dry bulb or effective temperature is subtracting for every week starting in the first week 5°F and 3°C for metric system.

Week	1	2	3	4	5	6
Temp. °F	90	85	80	75	70	65
Temp. °C	32	29	26	23	21	18
Reading	DB Temp.	DB Temp.	Effective T	Effective T	Effective T	Effective T

DB Temp. = Dry Bulb Temperature.