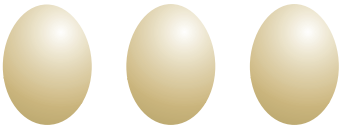
day 0

day 1

Hatching quality chicks



day 2

day 3

day 6

day 9

day 12

day 15

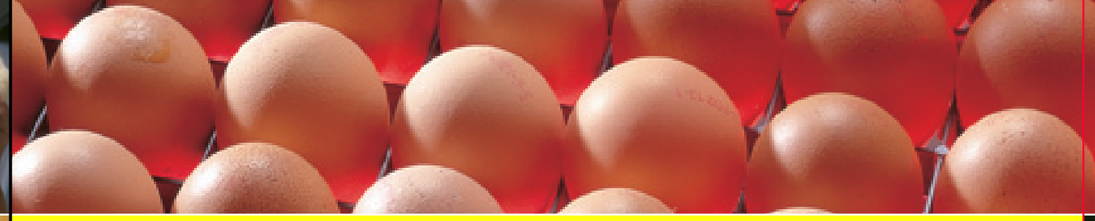
day 18

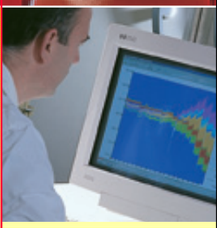
day 21

Embryos have different needs during the various phases of the incubation period. Pas Reform understands those needs and has designed incubators to the highest standards to provide optimal incubation conditions that maximise hatchability and chick uniformity. Incubators from Pas Reform promote the best chick quality, maximising growth and minimising feed conversion rates, which are essential for the profitability of poultry production.

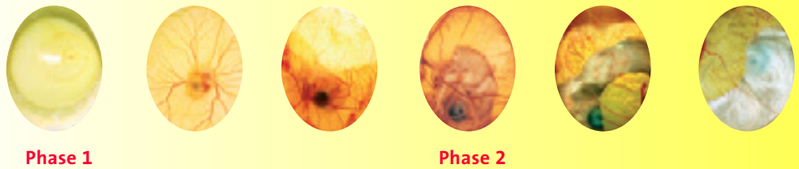
Pas Reform
Hatchery Technologies

Embryology

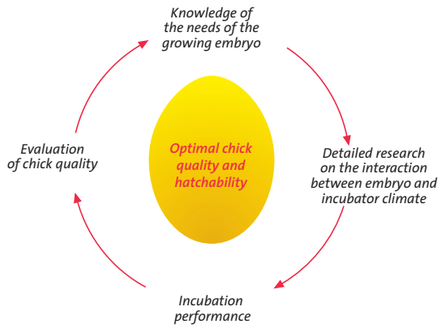




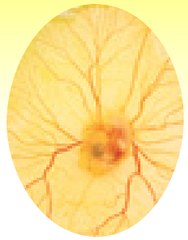
Good hatchability is no accident. During incubation the embryo passes through three critical stages of development before it is able to hatch successfully. Each phase requires specific conditions for optimum incubation and at all times the eggs benefit from a uniform distribution of temperature, humidity and respiratory gases.



Phase 1 Phase 2 Phase 3



Knowledge on interaction between embryo and incubator climate



Phase 1 – Development

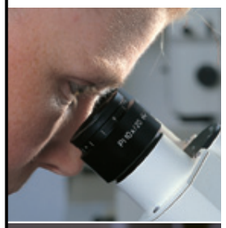
During phase 1 the embryo follows a sequence of complex morphological, physiological and biochemical changes that take it from a single cell immediately after fertilisation to an almost fully formed bird. The single cell undergoes several cellular divisions and the early phases of embryonic orientation (e.g. head and tail) occur in the oviduct. When the egg is laid the embryo is a sheet of cells segregated into groups that will eventually develop into specific tissues and organs.
During the first few days of incubation embryonic orientation is further established and repeated cell division and organisation produce the various tissues and organs of the bird. This gradual development of the embryo takes most of the first half of incubation. Growth of the extra-embryonic membranes and formation of the fluid compartments, which supply the developing embryo with nutrients and oxygen (O_2), also occur.

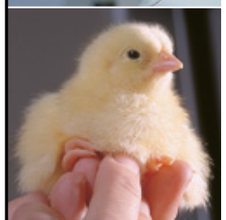
Phase 2 – Growth

Phase 2 takes place in the second half of the incubation period. By the middle of incubation the embryo has about 95 percent of its bodily organs and so only needs to increase in size in readiness for hatching. Maturation of its tissues (e.g. heart growth) continues until the bird is ready to hatch. The extra-embryonic fluids are also being used up as the embryo grows.

Phase 3 – Hatching

The first two phases occur in the setter, but the third and final phase occurs in the hatcher. During phase 3 the embryo undergoes a series of events that enable it to survive outside the protective environment of the shell. First, it breaks into the air space (internal pipping), allowing the lungs to start to take over respiration from the chorio-allantoic membrane. This membrane, which lines the inside of the eggshell, has enabled the embryo to breathe for much of its life in the egg. The lungs are fully functional about 24 hours after internal pipping, but the increasingly poor conditions within the egg force the chick to break the shell (external pipping). After a brief rest, hatching proceeds with the bird chipping at the shell to break off the end of the eggshell and emerge as an independent chick.



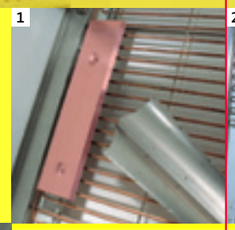


Phase 1 Development

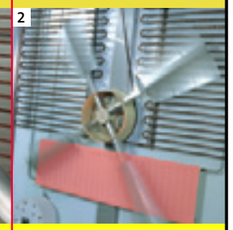
Temperature maintenance

Normal embryonic development in birds is possible only within a narrow range of temperatures (37-38 °C). As soon as the eggs arrive in the setter, heat must be provided from an external source in order to warm the embryo and maintain it at the desired temperature. This temperature must be continuously maintained at a stable level for development to proceed normally.

Phase 1

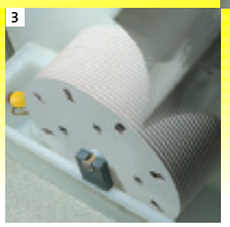


1



2

A high precision sensor located between the eggs measures the temperature of each incubation section (of 19,200 hen eggs) in a Pas Reform incubator. This sensor monitors the air temperature to obtain reliable temperature readings and controls the heating system of each incubator section, which is mounted directly behind the pulsator fan. Heater operation is based on PID control so that heat input is reduced as air temperature approaches the control setpoint. This serves to prevent temperature shocks to the eggs.
Pas Reform setters can be equipped with either electrical heating (see photo 1) or warm-water heating (see photo 2) . Warm-water heating assists in the even distribution of heat throughout the cabinet, providing greater heating capacity, reduced heat-up times and energy cost savings.



3

Air moves freely, parallel with the egg trays

4

5

Corridor The corridor in Pas Reform setters serves several important functions (see photo 5). First, it assists in the uniform flow of air around the eggs. Second, in combination with the small door in a Pas Reform setter, it allows inspection of the cabinet and systematic analysis of embryo temperature, without disturbing the internal climate of the setter. Third, it may also be used for temporary storage of setter trolleys when other incubators are being cleaned, undergoing maintenance, or when there is a peak in egg supply.

Incubator ventilation

Ventilation during incubation provides the setter with fresh air and prevents the cabinet air from becoming stale. During this phase of development the embryo produces little metabolic heat or carbon dioxide (CO_2) so air exchange during single stage incubation can be low.

Pas Reform's pulsator fan (one per incubation section) is designed to draw in fresh air and provide all of the eggs with a consistent environment (see photo 4). Valves in the air ducts control the amount of air exchange. Air moves freely, parallel with the egg trays, preventing development of 'dead spots' of little air movement and providing uniform distribution of heat, humidity and air within the cabinet, even when the setter is not completely filled with eggs.

Maintenance of humidity

The best possible hatchability and chick quality are attainable only if the eggs lose an optimum percentage of their initial weight prior to external pipping of the eggshell (10 to 15 percent, depending on maternal age and breed). This weight loss during incubation is entirely the result of the diffusion of water vapour through the eggshell pores. The porosity of the shell and the humidity of the air around the egg control this process. Shell porosity is fixed when the egg is laid. Weight loss during incubation is controlled by the relative humidity of the air in the incubator. Proper humidity is essential for the embryo because it keeps the egg from losing too much or too little moisture during the incubation process. Excessive water loss during the first days of incubation, when water is also being transported from the albumen into the yolk, could dehydrate the albumen and damage the embryo.

Pas Reform incubators have high precision wet-bulb temperature sensors or electronic humidity sensors to measure and control the humidity level (see photo 6) . Each incubation section has a water reservoir with plastic rollers that rotate to provide a large evaporating surface to rapidly introduce humidity when required (see photo 3). Pas Reform setters can also be equipped with a steam humidifier (optional).

6

Turning

Egg turning is necessary to ensure that the developing embryo is gently moved within the egg. This is important for the proper development of the extra-embryonic membranes and fluid compartments. Improper turning causes problems with utilisation of albumen (egg white). Egg turning is advised up to at least day 15 of incubation, but is normally maintained up to transfer at day 18.

Pas Reform setters employ a reliable, fully automatic, mechanical turning device that rotates the egg trays exactly 90 degrees every hour. Each setter trolley has an independent (adjustable) turning mechanism designed to avoid harmful physical shocks to the eggs (see photos 7 and 8).

7

8

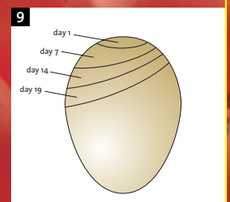
Precise egg turning

Phase 2
Growth

Temperature maintenance

Cell metabolism generates heat as a waste product and so as the embryos grow they produce more and more heat. After the mid-point of incubation eggs begin to produce excess heat. Although some metabolic heat is lost through the evaporation of water vapour from the egg and the transfer of heat to the air in the incubator, a cooling system is needed to remove the excess heat. This ensures adequate cooling of the egg to achieve an optimal incubation temperature for the embryo.

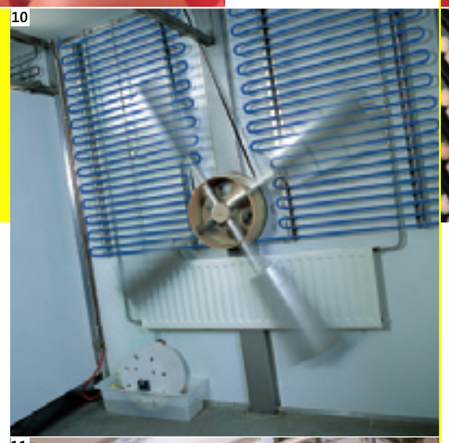
9



Phase 2

Each incubation section has a separate water-cooling system (see photo 10) mounted directly behind the setter's fan and activated by the temperature sensor. As for the heating system, there is PID control of the valves supplying cold water to the cooling system pipes. Water-cooling in Pas Reform setters ensures that they operate more independently of the climatic conditions in the setter room.

10

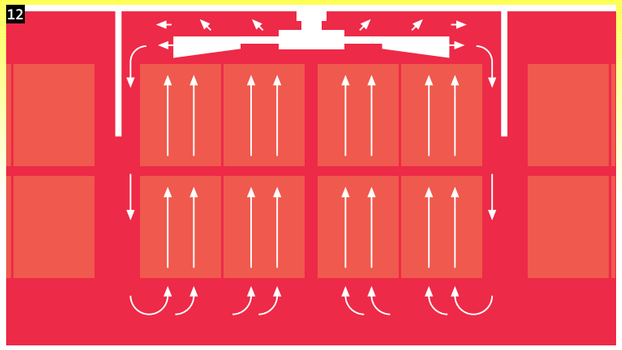


11

Sectional environmental control

Modular design Chick quality and hatchability depend on uniform temperature, humidity and airflow in the incubator. The modular design of Pas Reform incubators helps meet this requirement (see photo 11). Each incubation section has a capacity of 19,200 hen eggs, and is equipped with separate heating, cooling and ventilation controls. During incubation some sections may be cooling, while others are heating - the only way to guarantee an even incubation temperature and to create a stabilised micro-environment around the eggs.

12



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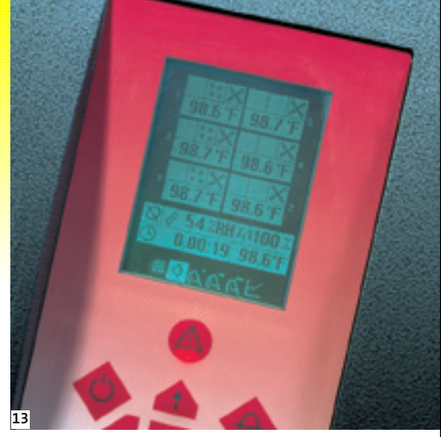


PID (Proportional Integral Derivative) control

Incubator ventilation

As the embryos grow during phase 2 their need for O_2 increases, and during single stage incubation the fresh air requirements of the setter steadily increases. Air exchange also assists in the removal of CO_2 and in controlling humidity. The need for uniform air distribution becomes even more crucial in phase 2.

The increased demand for fresh air is accommodated by opening valves in the air ducts in the top of each section of the incubator. The unique *Delta pulsator system* draws in fresh air from the setter room and circulates it throughout the cabinet. Partitions on each side of an incubator section direct the air along the side of the setter trolleys into the corridor of the incubator. The air is then pulled evenly through the egg trays and over the eggs back towards the pulsator to be mixed with incoming fresh air and re-circulated (see illustration 12).

Maintenance of humidity

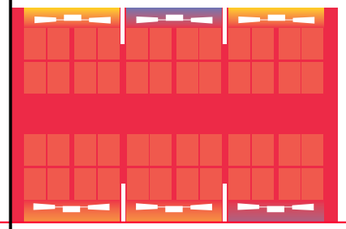
Maintaining an appropriate rate of water loss is necessary during phase 2 of development in order to produce a correctly sized air space (see illustration 9). This is essential in supplying adequate air within the shell for the final development of the lungs and air sacs of the chick. Water loss can also facilitate the natural control of embryonic temperature.

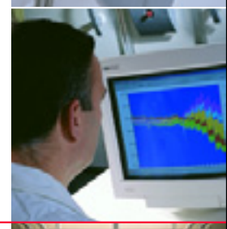
In a Pas Reform incubator the humidity can be easily adjusted by changing the setpoint.

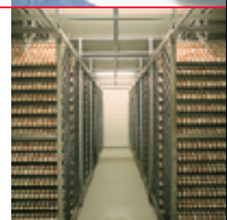
Incubation control

Precise control of the incubation environment is critical during every phase of embryonic development. It is especially important during the growth phase of development, when the embryo produces an excess of metabolic heat and high levels of CO_2.

A Pas Reform incubator employs the *Navigator control system*, which allows a specific incubation programme to be used for different batches of eggs (see photo 13). Using data from the temperature and humidity sensors, *Navigator* calculates the required environmental conditions for each incubator section as provided by the incubation programme. *Navigator* enables the hatchery manager to modify and store customised incubation programmes depending on the strain, egg quality, flock age, storage time, etc. The system can also be connected to a computer for remote monitoring and control of all incubators.







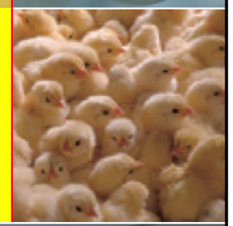
Single-stage and multi-stage incubation The modular design of Pas Reform incubators allows for both single-stage (All-in/All-out) and multi-stage incubation. With capacities ranging from 19,200 up to 115,200 hen eggs, Pas Reform supplies the largest single-stage incubators on the market! The increasingly popular single-stage incubation facilitates optimal incubation programming per batch and egg type, maximum hygiene and sanitation, flexible scheduling and reduced labour costs. Once the trolleys are in place the uniform environment in a Pas Reform setter eliminates the need to move them during the setting period (closed door setting).

Phase 3
Hatching

Temperature maintenance

Hatching is an active process during which the embryo generates even more metabolic heat. To prevent heat stress during this time, controlling the air temperature is particularly critical.

Pas Reform hatchers are equipped with water-cooling pipes incorporated in the aluminium wall panels (see photo 14). This results in a massive increase in the surface area for cooling, which helps to maintain uniform temperature distribution.



Phase 3

Incubator ventilation

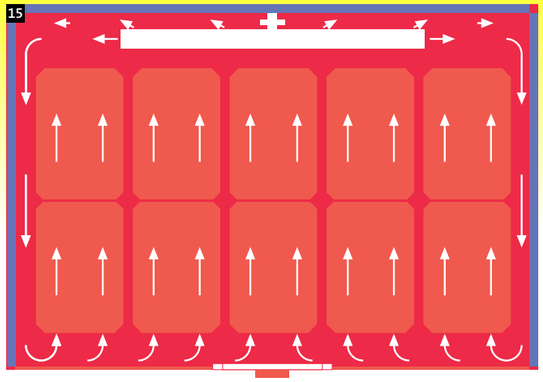
After internal pipping, the embryo's lungs and air sacs are first filled with air from the air space in the egg. The increasing levels of CO_2 caused by increased activity stimulate external pipping. After hatching the chicks must be provided with fresh air, which also helps to dry them after they have fully hatched.

14

Cooling system incorporated in aluminium panels

Trolleys and trays The use of trolleys, which are loaded outside the setter and hatcher, reduces demands on labour. Trolleys are made of highly durable, easy-to-clean, heavy-duty galvanised steel with large diameter swivel castors for easy manoeuvrability, which makes them ideal for on-farm traying. Trolleys filled with eggs are rolled directly into and out of the incubator, obviating the need for additional handling of egg trays. Pas Reform setter trays and hatcher baskets are durable and stackable, designed to allow maximum airflow around the eggs and are suitable for hatchery automation.

15



16

Easy to clean hatcher

Pas Reform hatchers achieve optimal air distribution and ventilation capacity by using ventilation openings in the ceiling (see photo 18). This 'open inlet' works very efficiently, thanks to the fan blades, which are designed to force the air along the back and side walls, with their in-built cooling pipes, to the front of the cabinet, where it is pulled through the hatcher baskets back towards the fan (see illustration 15). Valves in both the inlet and outlet pipes control the amount of fresh air entering the cabinet. Changes in the position of these valves provide optimum fresh air supply to maintain the correct CO_2 level during the different stages of hatching.

Maintenance of humidity

Once the eggshell is broken, water loss increases dramatically because shell porosity is no longer exerting a controlling effect. This is seen as the natural humidity in the hatcher increases as hatching proceeds. The high rate of air movement, necessary to ensure heat exchange, results in the quick evaporation of water from exposed surfaces of the shell membranes and embryo.

To prevent excessive drying out and to prevent the shell from sticking to the down, the wet-bulb temperature of the hatcher is increased. A nozzle that sprays water into the air on demand increases the humidity in the hatcher (see photo 19). Once hatching is complete the humidity is decreased to dry the chicks.

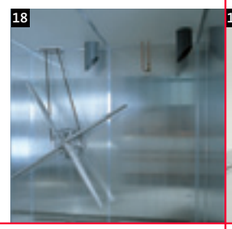
Hatcher hygiene

Hygiene in the hatchery is essential at all times, but especially during hatching, when there is a high risk of cross-contamination of the equipment, staff, eggs and chicks. Chick down poses a particular problem and its movement must be controlled.

To control the risk of contamination by disease organisms, Pas Reform uses easy to clean aluminium and polystyrene, both 'food safe' materials resistant to strong disinfectants. Smooth aluminium walls (with its cooling pipes inside the panels), and the absence of closed air ducts on top of the machine, make a Pas Reform hatcher very easy to clean and disinfect (see photo 16). A fluff corridor behind the hatcher to receive exhaust air allows chick down to settle out of the air before it is exhausted from the hatchery (optional) (see photo 17) . These features play an important role in preventing the spread of micro-organisms, particularly Salmonella and Campylobacter, within the food chain.

17

18



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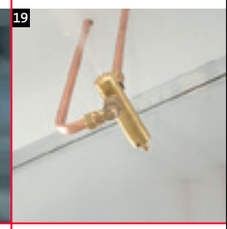
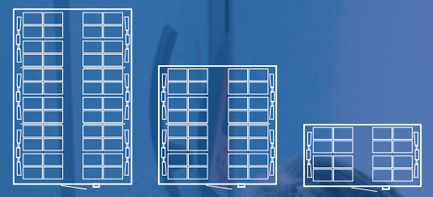


Compatibility Tiros hatchers are compatible with other makes of incubators and hatcher baskets, facilitating easy conversion of any hatchery to the Pas Reform system.

The setter

Type	Dinos 115	Dinos 77	Dinos 38	CD 57	CD 38	CD 19
Use	Single-Stage (All-In/All-Out) or Multi-Stage					
Capacity (hen eggs)	115,200	76,800	38,400	57,600	38,400	19,200
Dimensions (mm)						
Height (+ height of motor)	2,460 (+ 300)	2,460 (+ 300)	2,460 (+ 300)	2,460 (+ 300)	2,460 (+ 300)	2,460 (+ 300)
Width	4,835	4,835	4,835	2,940	2,940	2,940
Depth	7,271	4,933	2,595	7,271	4,933	2,595
Number of trolleys	24	16	8	12	8	4
Number of (150 eggs) trays	768	512	256	384	256	128
Tray dimensions (mm)	507 x 733					
Incubation sections (each holding 19,200 hen eggs)	6	4	2	3	2	1
Heating	Warm water or electrical heater in each incubation section					
Cooling	Water cooling system in each incubation section					
Ventilation	Delta pulsator system in each incubation section					
Humidification	Humidity roller in each incubation section, or steam humidifier					
Turning	Automatic - once an hour through 90° (adjustable)					
Incubation control	Navigator					
Temperature control	Temperature sensor in each incubation section					
CO_2 monitoring	Yes (optional)					



Dinos 115 Dinos 77 Dinos 38

CD 57 CD 38 CD 19

See www.pasreform.com for a 360° view of the setter and the hatcher.

The hatcher

Type	Tiros
Capacity (hen eggs)	19,200
Dimensions (mm)	
Height (+ height of motor)	2,445 (+300)
Width	3,235
Depth	2,242
Number of dolleys	5
Number of baskets (150 eggs per basket)	128
Heating	Electrical heating
Cooling	Water cooling system incorporated in aluminium walls of cabinet
Ventilation	'Open inlet' system
Humidification	Humidity roller, spray nozzle or steam humidifier
Incubator control	Navigator
CO_2 monitoring	Yes (optional)

Tiros

In our commitment to quality improvement through continuous research, we reserve the right to alter specifications of our products without notice.

Pas Reform Hatchery Technologies

Pas Reform is an independent international company, which has specialised in the development of innovative hatchery technologies since 1919. The company is the leading hatchery equipment manufacturer of the world. Pas Reform owes this position to its longstanding research into the biological and physical aspects of embryo development and physiology.

PASREFORM
HATCHERY TECHNOLOGIES

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