21 Days of Incubation

Chickens should hatch on day 21 of incubation.

The elapsed time between first chick and last chick should be no more than 24 hours.

While each incubator and each batch of eggs are unique, hatch time should be pretty consistent. Evaluating imperfect hatch results will help us identify flaws in our incubation method, take corrective actions, and ultimately improve our techniques. After each batch, I consider each of the following items to discover how I can make the next batch better:

GOAL 1: THE HATCH SHOULD BE COMPLETE BY THE END OF DAY 21

- **MOST EGGS HATCH LATE: POWER OUTAGE**: If the electricity goes off or the incubator inadvertently becomes unplugged, the temperature will drop. While most eggs can tolerate lower temperatures for several hours, the hatch will be delayed. Small eggs lose heat faster than large eggs and will usually hatch even later.
- **MOST EGGS HATCH LATE: LOW AVERAGE TEMPERATURE**:

> *Yep, I had my thermometer in the wrong place (taped in the window at top) first hatch - failed miserably it was a 10° degree difference!* *Nichole Hansen, Backyard Chickens*

  - **THERMOMETER PROBE TOUCHING EGG SHELL**: As the chick grows, it begins to generate its own heat through metabolism. As development progresses, the shell temperature becomes warmer (101° F) than the circulated air. If the bulb or probe is resting on the egg shell, the thermometer will read high.
  - **THERMOMETER PLACEMENT LEVEL TOO HIGH**: Warm air rises and cool air sinks. The incubator's temperature should be measured at the TOP of the eggs especially for still air incubators. While the fan in desktop forced air models circulates air, they still experience heat layering and the thermometer probe should be kept at egg top level.
  - **THERMOMETER INACCURATE**: Digital thermometers should be accurate to ±0.2° F. Unfortunately, most are only accurate to ±2.0° F meaning if the display reads 99.5° F the actual temperature can be anywhere from 98.5° F to 100.5° F. when buying a digital thermometer ensure that it is accurate to ±0.2° F.
  - **THERMOMETER UNCALIBRATED**: Most thermometers claim to be calibrated at the factory, but almost all thermometers are incorrect. Thermometers should be calibrated by placing its bulb/probe in a pan of crushed ice and water – the thermometer should read 32.0° F.
  - **THERMOMETER PROBE/BULB IN COOL SPOT**: All incubators have warm and cool spots. If the thermometer is kept in a warm spot, then the overall temperature will be cooler than needed. When regulating your incubator, measure the temperature is several different areas. Place the thermometer in an area that is neither cool not warm.
- **MOST EGGS HATCH EARLY: HIGH AVERAGE TEMPERATURE**:

> *Because overheated chicks hatch earlier than they should, they are often smaller, weaker and more prone to infections as well as a host of other health problems.* *Cobb Hatcheries*

  - **THERMOMETER PLACEMENT LEVEL TOO LOW**: Warm air rises and cool air sinks. The incubator's temperature should be measured at the TOP of the eggs especially for still air incubators. While the fan in desktop forced air models circulates air, they still experience heat layering and the thermometer probe should be kept at egg top level.
  - **THERMOMETER INACCURATE**: Digital thermometers should be accurate to ±0.2° F. Unfortunately, most are only accurate to ±2.0° F meaning if the display reads 99.5° F the actual temperature can be anywhere from 98.5° F to 100.5° F. when buying a digital thermometer ensure that it is accurate to ±0.2° F.
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- **THERMOMETER PROBE/BULB IN WARM SPOT**: All incubators have warm and cool spots. If the thermometer is kept in a warm spot, then the overall temperature will be cooler than needed. When regulating your incubator, measure the temperature is several different areas. Place the thermometer in an area that is neither cool not warm.

GOAL 2: ALL CHICKS SHOULD HATCH WITHIN A 24 HOUR PERIOD (HATCH WINDOW)

- **EGGS STORED ABOVE 70° F**: A chicken embryo begins to grow before the hen lays the egg; however, this process ceases at temperatures below 70° F permitting hens to lay full clutches before incubation begins.[1] Common practices allow eggs to be stored at room temperature for seven to ten days; unfortunately, older eggs may experience greater development than newer ones as room temperature approaches 80° F. For best results, store eggs below 70° F (55-65° F) allowing them to warm to 75-80°F prior to setting.

> *Cooling at ordinary temperatures will not kill the embryo, and it will begin to develop again when the egg is placed in the incubator. Keeping eggs at temperatures above about 80° F (27 C) prior to incubation will cause a slow growth which leads to a weakening and eventual death of the embryo.* *University of Illinois, 1988*

- **HOT & COLD SPOTS INSIDE INCUBATOR**: Few incubators maintain perfectly even temperatures in all areas – some spots will be warmer and some spots cooler – differing as much as one full degree. Fans help circulate the air reducing temperature variations; however, automatic egg turners, covering the mesh flooring, and cramming eggs into a small space decrease air flow and fan effectiveness. Many hobbyist set their eggs in the turner and then hope that the incubator will do all of the work; unfortunately, eggs resting in a cool spot for the entire incubation will hatch later than those resting in a warm spot. For best results, eggs should be shuffled periodically – eggs in the center moved to the sides and those on the sides to the center.

> *Broody hens provide optimum conditions for embryos developing in the eggs they are sitting on. The brood patch provides heat from one direction only, and the eggs at the side of the patch are cooler than those in the middle of the nest. However, because the broody hen regularly* ***turns and moves*** *the eggs in the nest, uniform egg temperature is achieved.* *Pas Reform Hatchery Technologies*

- **EGGS STORED DIFFERENT LENGTHS OF TIME**: According to Cobb Hatcheries, not only does prolonged storage decrease hatchability (about 1% for each day after the initial six) but it also prolongs incubation time, "On average, one day's storage adds one hour to incubation time."[2] To decrease the storage effect, eggs should be carefully stored using the following recommendations. Warm eggs for 4-6 hours before setting.

Hubbard Hatcheries	Days of Storage 1-2	3-4	5-6	7-8	9-12	13-16	17-20
Temperature	**66.2°F**	**62.6°F**	**59.9°F**	**57.2°F**	**54.5°F**	**53.6°F**	**52.7°F**
Humidity	70.0	80.0	85.0	90.0	90.0	90.0	90.0
Turning	No	No	No	No	Yes	Yes	Yes
Small end up	No	No	No	No	Yes	Yes	Yes

- **EGGS FROM YOUNG & OLD HENS**: Research indicates that eggs from hens 32-45 weeks old produce the healthiest and most vigorous chicks. Unfortunately, most home flocks consist of hens from various age groups. For best results, attempt to avoid eggs from very young or very old pullets. While these may produce healthy chicks, they expand the hatch window and experience more difficulties.

> *Maternal age directly affects the rate of embryonic development. Embryos from 'pubescent' flocks (< 32 weeks) require longer incubation periods than embryo's from 'mature' flocks (>32 weeks).* *The Poultry Site, 2006.*

- **EGG SIZE VARIATIONS**: Within an environmentally stable and consistent environment, small eggs will hatch at the same time as large eggs. When the temperature within an incubator is inconsistent – bounces up and down – smaller eggs will hatch significantly earlier or later than larger eggs – small eggs heat up and cool down faster. If this occurs, consider your incubator placement and move to a location free of drafts, heating/cooling vents, and direct sunlight or a room with a more stable environment.

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[1] *from Gaylene M. Fasenko, "Optimal egg storage conditions," University of Alberta, 2006*

[2] *"Hatching egg storage and transport," Cobb Hatcheries, NDA, <http://www.cobb-vantress.com/cobb-academy/overview/blog/detail/cobb-academy/2012/12/14/hatching-egg-storage-and-transport>*

Standard Chicken Incubation Timeline

Roberts Farm

Day	Hours	
1st	0 4 P.M.	Set Eggs
2nd	24 4 P.M.	
3rd	48 4 P.M.	
4th	72 4 P.M.	
5th	96 4 P.M.	
6th	120 4 P.M.	
7th	144 4 P.M.	
8th	168 4 P.M.	1st Candling
9th	192 4 P.M.	
10th	216 4 P.M.	
11th	240 4 P.M.	Check Questionable Eggs
12th	264 4 P.M.	
13th	288 4 P.M.	
14th	312 4 P.M.	
15th	336 4 P.M.	2nd Candling
16th	360 4 P.M.	
17th	384 4 P.M.	
18th	408 4 P.M.	
19th	432 4 P.M.	Stop Turning ↑65-70% RH
20th	456 4 P.M.	1st Internal Pip
21st	480 4 P.M.	1st External Pip
	504 4 P.M.	Hatch Begins
		Hatch Complete

↑ Temperature: Circulated Air 99.5°F -- Still Air 101.0-10.5°F ↓

↑ Humidity 43-48% ↓

↑ 65-70% ↓