

Beginner's Incubation Guide

Small Desktop Incubation

TARGET AUDIENCE: Chicken eggs takes 21 days of incubation under a specific temperature and humidity. While not rocket science, the challenge can seem overwhelming for beginners. This guide is intended to assist inexperienced hobbyists who want to incubate a small number of eggs in a desktop foam incubator.

EGG COLLECTION & STORAGE: Proper egg collection and storage has a significant impact on hatching success.

1. Use fresh, large pine shavings to line nesting boxes or nesting areas. Replace any soiled lining as soon as it becomes contaminated.
2. Thoroughly **WASH YOUR HANDS** prior to collection and use a clean container for collection.
3. Collect eggs two or three times a day, more frequently if temperatures are unusually high or low.
4. Remove eggs that are unusually dirty, large, small, or misshaped as these eggs hatch poorly and consume valuable incubator space.
5. Using a pencil or non-toxic marker, label eggs with the species, pen, date laid, and any other important information. These markings aid in identifying hatchlings and assist with accurate record keeping.
6. **DO NOT WASH** or wipe off dirt or waste from the egg. If the egg is marred by a small amount of waste, allow it to dry and then gently scrape it off with a finger nail. Washing, wiping, or sanding dirty eggs removes the bloom, the natural antibacterial coating and also pushes any contamination into the pores.
7. Store eggs in new, paper cartons with the small end down at a temperature between 65-69°F. Tilt the container to its side 45° and change the direction daily. Do not store eggs in the refrigerator as the temperature is too cold and will have a negative impact on hatching and chick health.
8. For best results, store eggs for no longer than 10 days. However, clean eggs stored at 55-62° F and a humidity of 70% and turned daily can remain viable for up to 21 days.

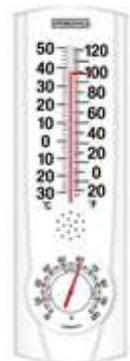


Whenever possible, **AVOID** mixing eggs in different stages of development in the same incubator – doing so complicates hatching and may lead to poor results. It is better to collect and carefully store eggs for 14-18 days and hatch all eggs at the same time.

9. Allow cool eggs to warm to 75-80° F for 4-6 hours before to placing in the incubator.
10. **SHIPPED EGGS:** Shipped eggs should be allowed to settle with the large end pointed up for at least 24 hours prior to setting. This settling may help any detached air cell to reattach before incubation.

THERMOMETERS: An accurate and consistent temperature is essential to a successful hatch.

1. **DO NOT TRUST** the gauges built into the incubator and **DO NOT** use the small, cheap thermometers that might have come with your incubator.
2. An inexpensive red spirit filled, glass thermometer is well suited for desktop incubation:
 - They react well to changes in temperature without overreacting like digital ones.
 - They are easily obtained from Wal-Mart, Lowe's, or Tractor Supply.
 - They are easily calibrated to ensure temperature readings are accurate.
 - They are necessary when checking the accuracy of digital thermometers.
 - They are not difficult to read if you draw a clear red line at the target temperature.



3. When buying a separate digital thermometer, **BE SURE** that it has an **ACCURACY** of not less than $\pm 0.2^\circ$ F.



There is a huge difference between **READOUT PRECISION** and **ACCURACY**. Although a thermometer may read 99.5° F, it may not be accurate to that 0.1° . Carefully check the package and be sure it says, "Reads to 0.1° F with an accuracy of $\pm 0.2^\circ$ F."

4. **DO CALIBRATE** your thermometer by submerging in settled ice water. It should read 32° F. Most digital thermometers cannot be calibrated but must be checked against an old fashion glass thermometer. To calibrate a glass thermometer, submerge it in melting ice water – it should read 32° F. If not, loosen the glue, slide the glass portion up or down until it is accurate, and then place a drop of hot glue to reattach.

INCUBATOR PREPARATION: Incubators should be calibrated **AT LEAST TWO DAYS BEFORE** setting eggs.

1. Read the instructions that came with the incubator. While most provide very little information, the instructions will help you learn how to operate your incubator and troubleshoot most problems.
2. Place your incubator in a room with a steady temperature. Place the incubator away from heating/cooling vents, direct sunlight, or drafts. It is impossible to maintain a consistent incubator environment if room conditions are constantly changing. Many beginners find it helpful to place their incubators in an unused closet or bathroom.
3. Place your separate, calibrated thermometer in the middle of the incubator where it is easily visible through the viewing pane. Use this thermometer to calibrate your incubator's temperature.
4. Turn on your incubator and allow a warm-up period of no less than two or three hours. When making adjustments, make only small ones and allow at least one hour between adjustments. Do not expect the temperature calibration to take less than 24 hours.



AVOID getting in a hurry to set your first batch of eggs. Most beginners get into trouble by not taking the time to ensure that their incubator is operating properly, that the temperature is steady, and that the humidity is constant.

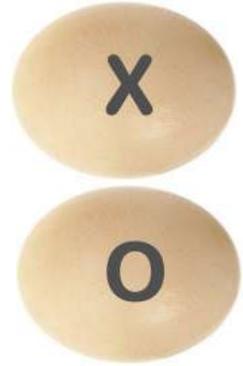
5. **TEMPERATURE SETTINGS:** Temperature should be measured at the top of the eggs. When calibrating your incubator, place your thermometer on top of eggs that you can throw away when the calibration process is complete. Circulated air incubators (those with a fan) operate best at a consistent temperature of 99.5° F. Still air incubators (those without a fan) operate best at a consistent temperature of 101.0 - 101.5° F. Your incubator instructions may give a different recommended temperature; for best results, follow your incubator instructions.
6. **HUMIDITY SETTINGS:** The best humidity setting for chicken eggs is often debated. I prefer a humidity of between 43% and 48% for days 1-18 increasing the humidity to about 70% on days 19-21. When calibrating your incubator, fill only one water chamber at first. Check your humidity, and fill a second chamber if your reading is low. **DO NOT TRUST** the built in gauge rather use a separate hygrometer.



CHECKING YOUR HYGROMETER: Dampen a towel (not dripping wet) then wrap the hygrometer in the towel for 30 to 45 minutes. Then unwrap it and quickly read the humidity; it should read exactly 100%. You should make a mental note of how far over or under the actual humidity is from the reading from your hygrometer.

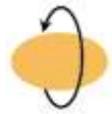
SETTING EGGS – NO AUTOMATIC TURNER: *DO NOT* attempt to set any eggs until the incubator's temperature and humidity has been stable for at least 24 hours doing so will lead to multiple problems that are difficult to correct once eggs are in the incubator.

1. Allow the eggs to warm if they have been stored below 75-80° F.
2. Using a pencil, mark one side of each egg with an **X** and the other side with an **O**. These markings will help ensure that each egg is completely turned.
3. Lay the eggs on their side, on top of the mesh, in the middle of the incubator. It is perfectly fine for the eggs to touch but they should not be overly crowded or stacked.
4. Close the lid, walk away, and do not return for several hours. It is normal for the incubator to take some time before warming to the set temperature. It is also not uncommon for the temperature to spike a degree or two above the set temperature after setting eggs. *Avoid fiddling with the thermostat during the first 24 hours.*
5. Before opening the incubator to turn your eggs, examine your temperature and humidity readings. While you will need to occasionally add water to keep the humidity up, you should not need to touch the thermostat. If the temperature is off, do nothing and check the temperature in another hour. If the thermometer continues to read high or low, you may carefully make a small adjustment.



 Temperatures normally fluctuate from time to time. If your incubator has difficulty maintaining the set temperature, look at where you placed your incubator... perhaps a more stable place will help. Always be reluctant to alter your thermostat settings as fiddling with the thermostat frequently causes more problems than it solves.

6. Three times a day – morning, afternoon, and bedtime – move the eggs in the middle to the edge and roll the ones on the edge to the center. Check to ensure that each egg has been turned by checking your **X**'s or **O**'s.



SETTING EGGS – WITH AUTOMATIC TURNER: *DO NOT* attempt to set any eggs until the incubator's temperature and humidity has been stable for at least 24 hours doing so will lead to multiple problems that are difficult to correct once eggs are in the incubator.

1. Allow the eggs to warm if they have been stored below 75-80° F.
2. Identify the large (fat) end of the egg and draw a small circle on that end with a pencil. If you have difficulty determining which end is the large on, place a small flashlight on each end – the large end contains the air cell.
3. Place the eggs in the center section of the turner with the large end up – the pointy end down.
4. Close the lid, plug in the auto-turner, walk away, and do not return for several hours. It is normal for the incubator to take some time before warming to the set temperature. It is also not uncommon for the temperature to spike a degree or two above the set temperature after setting eggs. *Avoid fiddling with the thermostat during the first 24 hours.*
5. Twice daily check your temperature and humidity. While you will need to occasionally add water to keep the humidity up, you should not need to touch the thermostat. If the temperature is off, do nothing and check the temperature in another hour. If the thermometer continues to read high or low, you may carefully make a small adjustment.



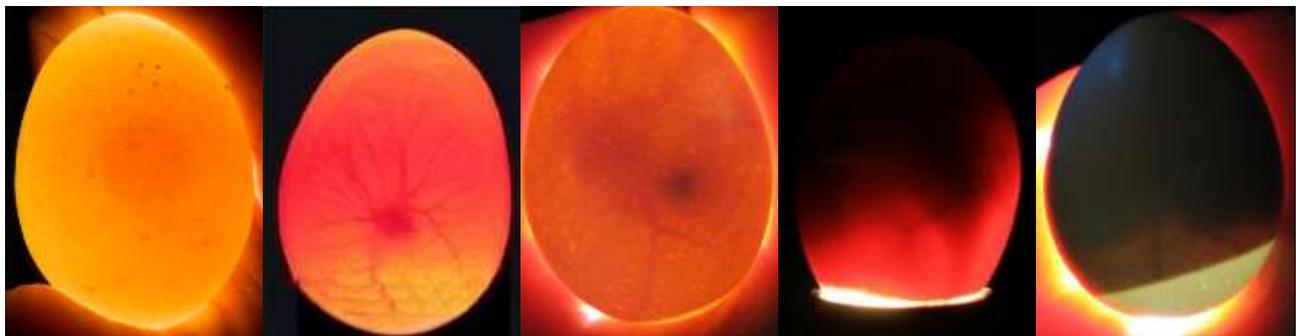


Temperatures normally fluctuate from time to time. If your incubator has difficulty maintaining the set temperature, look at where you placed your incubator... perhaps a more stable place will help. Always be reluctant to alter your thermostat settings as fiddling with the thermostat frequently causes more problems than it solves.

6. Some automatic turners turn at a very slow pace and you may not see any motion. Occasionally, take a look at which way the eggs are tilted. You know that your egg turner is working when the eggs are tilted in different directions at various times.

CANDLING EGGS: Candling is not a necessity but can help ease anxiety about how eggs are progressing.

1. Candling is the process of applying a strong light to the outside shell allowing a glimpse of the inside. A small LED flashlight and a dark room is sufficient to candle lightly colored eggs, many utilize their smart-phone flashlight app.
2. Most people candle their eggs on day 7, 14, and 18. However, on day 4 you should be able to see a small reddish embryo with blood vessels in white eggs. For darker colored or thick eggs, you may not be able to see anything but a dark shadow on day 10.



Day 0

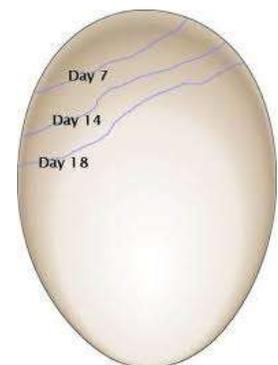
Day 4

Day 7

Day 14

Day 18

3. Eggs that are clear and show no signs of development may be discarded on day 14. If in doubt, leave the egg in the incubator. If an egg develops a bacterial infection, it probably will develop an odor. You can locate the bad egg by sniffing each egg individually.
4. Potential problems such as cracks or internal bacterial infections. Eggs that demonstrate problems should be removed as early as possible to prevent possible contamination of other eggs.
5. You will also want to examine the size of the air cell. The longer the egg is in the incubator, the more water will evaporate. This is normal. If the humidity is too high, the air cell will be small. If the humidity is too low, the air cell will be large. The air cell should approximate the size illustrated to the right.
6. For illustration of normal development visit: <http://www.backyardchickens.com/t/261876/chicks-are-here-egg-candling-pics-progression-through-incubation>.



HATCHING: How many chicks will hatch? There are numerous variables involved in incubation and if any single variable goes wrong, a chick will not hatch. For your first few hatches, focus on your successes not your failures.

1. **TIMING:** Lockdown begins at the end of day 18 and includes days 19, 20, and 21.
2. **AIR VENTILATION:** Remove all plugs from ventilation holes. Hatching requires great physical exertion and the chicks need fresh air in order to prevent exhaustion and possible death.
3. **TURNING:** Eggs should be removed from the turner and placed on their side with the large end angled slightly upward.



Some hobbyists prefer to allow eggs to stay in the turner during hatching; they simply unplug the automatic turner. Eggs remaining in the upright position place the chick in an unnatural position delaying hatching and making zipping more difficult. For best results, remove the eggs from the tray and lay them on their side.

4. **HUMIDITY:** Humidity should be increased to 65-70%. Fill all chambers in the lower portion of the incubator with water. If additional moisture is needed, add as many warm, wet sponges as needed.



Many beginners become overly worried about humidity during these last three days. If a small amount of moisture forms on the viewing pane then you know your humidity is sufficient. When the chicks begin to emerge, the humidity will naturally increase – don't worry, the chicks will not drown from this extra humidity.

5. **CLOSED LID:** Close the incubator lid and keep it closed. Open the incubator only if additional water is needed performing the task as quickly as possible.



The membrane that protects the chick from outside bacteria or an excess loss of water during incubation can dry out in as little as 60 seconds if humidity is lost during the hatching process. Once dried out, this membrane prevents the chick from hatching and becomes a death shroud. Guarding your humidity – it's a matter of life and death.

6. **INTERNAL PIPPING:** One or two days before hatching, the chick will puncture the air cell membrane with its beak and begin to breath. You may hear chirping at this time. If the humidity level is low during this time, the air cell membrane may dry out making it difficult or impossible for the chick to puncture it. Chicks who cannot puncture this membrane will eventually suffocate – they will drown.
7. **EXTERNAL PIPPING:** On the day of hatch, the chick will punch a small hole in the shell – pipping. After the initial pip, the chick may rest for 12 or more hours before continuing.
8. **ZIPPING:** Once the initial hole is made, the chick will turn inside the shell and proceed to make a crack around the diameter of the shell – zipping. If the humidity is low during this process, the membrane may dry out, shrink, and the chick may become stuck – shrink wrapped. The task of zipping may take anywhere from a few minutes to a few hours.
9. **EMERGENCE:** Once zipping is complete, the chick may rest for a spell. Once it regains strength, it will push against the bottom of the shell using its feet eventually freeing itself from the shell.



Assisting a chick too early can easily result in permanent harm or death. In most cases, a healthy chick will rest periodically and will emerge in time. If you decide you must assist a chick, please use caution and follow the advice in the following article:

<http://www.backyardchickens.com/a/step-by-step-guide-to-assisted-hatching>

10. **UMBILICAL CORD:** Prior to hatching, the chick will absorb the remainder of the egg yolk and the blood vessels attached to the shell contents will dry out. If a chick emerges too quickly, what appears to be an umbilical cord will be attached to its bottom. This cord will fall off without any assistance.
11. **HERNIATED YOLK SAC:** On rare occasions, a chick will emerge from its shell before the egg yolk is completely absorbed – herniated yolk sac. It should absorb on its own if the area remains moist.
12. **PATIENCE:** Even the experienced feel anxiety at hatch time; beginners may be overwhelmed with excitement and concern. Be patient. Mother Nature has designed each step in the process for a reason and each step takes time.
13. **EARLY HATCHING:** If the incubation temperature has been a little high throughout incubation or the eggs are small, the chicks may begin to hatch early. If they do, there is little you can do except maintain your temperature and humidity.
14. **LATE HATCHING:** If the incubation temperature has been a little low throughout incubation or the eggs are large, the chicks may begin to hatch late. If they do, there is little you can do except maintain your temperature and humidity.
15. **ENDING THE HATCH:** How long should you give an egg to hatch? Many people wait 2-3 days after the due date before discarding unhatched eggs. Personally, I will end the hatch a few hours after any visual activities have stopped. With experience, you will adopt your own preference on how long to wait.
16. **REMOVING HATCHLINGS:** Hatchlings should be completely dry and actively moving about before removing from the incubator. Hatchlings absorb their egg yolk just prior to hatch and can easily survive 48-72 hours after hatch without food or water. In most cases, it is best to wait until the entire hatch is complete before removing any hatchlings... Do not be in any hurry to remove hatchlings.
17. **CLEAN-UP:** Although styrofoam incubators appear flimsy and easy to destroy, they are actually durable. After the hatch, gently remove gunk using dish soap and a gentle brush – some soaking may be necessary. Then saturate all non-electronic surfaces with a 10% bleach solution, rinse completely, and allow to air dry. Bright sunlight is one of the most effective means to disinfecting your incubator.
18. **HATCH EVALUATION:** In order to improve future hatches, carefully consider what went right and what went wrong with each batch. Consider the following:
 - **DID THE CHICKS HATCH ON TIME?** If they hatched early, then your temperature may have been a little high. If they hatched late, then your temperature may have been a little low. You may need to recalibrate your thermometer.
 - **DID ALL EGGS HATCH WITHIN A 24 HOUR PERIOD?** If more than 24 hours transpired between the first chick and the last chick, then you may have warm and cool spots. Randomly moving the eggs around periodically will prevent an egg from staying within a warm or cool spot for a long period of time. Additionally, eggs will begin developing if they are stored in temperatures above 70° causing older eggs to hatch a little earlier than fresh ones. When possible, store eggs at below 70°.
 - **EGGTOPSY:** Not all chicks will hatch. There are multiple reasons why this occurs from hen nutrient deficiencies, cold temperatures during collection, bacterial contamination, genetic flaws, and flaws in incubation methods. Eggs that did not hatch should be opened and examined to determine, if possible, why the chick failed to hatch. The following link from The Chicken Chick provides an excellent look at the stages of development: <http://www.the-chicken-chick.com/2012/03/chicken-embryo-development-views-from.html>.

PROBLEM SOLVING

Problem	Possible Causes
Eggs candle clear	<ul style="list-style-type: none"> ◆ Rooster too young or too old ◆ Too many hens for each rooster ◆ Poor hen health ◆ Eggs stored at below 40° F
Eggs candle clear with blood ring present	<ul style="list-style-type: none"> ◆ Eggs stored too long ◆ Eggs stored at wrong temperature ◆ Spike in temperature ◆ Excessively high temperature ◆ Hens too old or in poor health
Dead embryos before day 18	<ul style="list-style-type: none"> ◆ Insufficient turning ◆ Lack of ventilation ◆ Dirty eggs – pores blocked ◆ Egg contamination ◆ Hens too old or in poor health
Eggs pipped but not hatched <i>Chick dead in shell</i> <i>Sticky chicks</i> <i>Shell sticking to chick</i>	<ul style="list-style-type: none"> ◆ Low average humidity ◆ Low average temperature ◆ Low humidity at hatching time ◆ Insufficient turning ◆ Lack of ventilation
Chick pips wrong end	<ul style="list-style-type: none"> ◆ Eggs incubated small end up ◆ Inadequate turning ◆ Not placed on side end of day 18
Eggs hatch early	<ul style="list-style-type: none"> ◆ Temperature too high ◆ Small eggs ◆ Humidity too low days 1-18
Eggs hatch late	<ul style="list-style-type: none"> ◆ Temperature too low ◆ Large eggs ◆ Humidity too high days 1-18
Hatch window longer than 24 hours	<ul style="list-style-type: none"> ◆ Eggs stored above 70° F ◆ Temperature variations in incubator ◆ Mix of both large and small eggs ◆ Mix of eggs from young and old hens ◆ Eggs stored for different lengths of time
Crippled chicks	<ul style="list-style-type: none"> ◆ Air cell too large – low overall humidity ◆ Poor nutrition of hens ◆ Genetic defects
Weak chicks	<ul style="list-style-type: none"> ◆ Temperature too high at hatching ◆ Lack of ventilation ◆ Contaminated eggs

INCUBATION CHECKLIST

This checklist highlights several important factors to consider during the incubation process but does not serve as a substitute for reading and understanding all factors outlined in this guide.

- DO** prepare your breeding stock prior collecting incubation eggs including selecting the best, unrelated parents, worming your birds, feeding high quality feed, and cleaning nests, & renewing nesting material.
- DO** carefully plan your incubation and hatch schedule. Whenever possible, avoid setting eggs at different times or of different species unless you have a second incubator dedicated to hatching only.
- DO NOT** wash or refrigerate eggs for incubation. For best results, use eggs that are less than 7 days old. However, eggs up to 18 days old can be successfully hatched if stored correctly.
- DO** consider the accuracy of any digital thermometer you decide to purchase. Most thermometers are only accurate to ± 1.0 to 2.0° when an accuracy of ± 0.1 to 0.2° is needed.
- DO NOT** trust the gauges built into your incubator. **DO** use a separate, calibrated thermometer to monitor the incubation environment. Improper temperature control is the primary reason for hatch failure.
- DO** place your incubator in a room with a steady temperature, away from windows, drafts, or direct sunlight. Difficulties with regulating an incubator are often the result of poor incubator placement.
- DO** calibrate and regulate your incubator at least 48 hours prior to setting eggs. For best results, use water bottles to fill empty space during the regulation and calibration process.
- DO** become familiar with warm and cool spots within your incubator by measuring the temperature at various locations during the regulation and calibration process.
- DO NOT** keep your eggs in the same spot for the entire incubation period. For best results, move the eggs sitting on the outer edges to the center and the eggs sitting in the center to the outer edges daily.
- DO NOT** fiddle with the thermostat while eggs are in the incubator. Some fluctuation in temperature is normal and you're likely to cause more problems by fiddling with the temperature controls.
- DO** remove any automatic egg turner at the beginning of day 19 to avoid injury or death of newly emerged hatchlings.
- DO** completely fill troughs/pans full prior of water prior to lockdown – the last three days of incubation. **DO NOT** open the incubator unless absolutely necessary until the hatch is complete.
- DO** add sufficient warm, wet sponges during lock down to raise the humidity to at least 65% or until a small amount of moisture accumulates on the viewing pane.
- DO** remember that chicks burn a great deal of oxygen during the hatching process. **DO** remove any vent plugs during lockdown. **DO NOT** sacrifice fresh air for humidity during the final days.
- DO** remember that hatchlings live for 48-72 hours after hatch by feeding from the absorbed egg yolk. The bumping of unhatched eggs by hatchlings encourages the unhatched to pip, zip, and emerge.
- DO** remember that 12 or more hours may elapse from the first pip to the first emergence and that hatching is an exhausting process... hatchlings may rest for extended periods of time during the process.
- DO NOT** assist eggs during the hatching process unless it is absolutely necessary. In most cases, a healthy hatchling will emerge on their own and assisting can easily cause more harm than good.
- DO** carefully evaluate your hatch results using the recommendations in this guide. **DO** view each hatch as a learning process with a primary goal of improving with each subsequent batch.
- DO NOT** forget that home flock hatching should be an enjoyable process... not every egg will hatch and not every hatchling will survive. Celebrate your successes and do not focus on your failures.

SIMPLE FACTS, TIPS, & TRICKS

BAD EGGS:

- ◆ Eggs with severe bacterial infections can be identified during candling by multiple small dark spots floating within the egg or by an unusually large dark area. For best results, compare a questionably bad egg with other eggs that possess a normal appearance.
- ◆ There should be very little odor coming from your incubator. If you notice an unusual smell, open the incubator and sniff each egg individually. Removing any egg that smells will reduce the chances of a bad egg leaking or exploding and contaminating other eggs within the incubator.

CLEANLINESS:

- ◆ Placing porous, cloth shelf liner placed on top of the mesh prior to hatching will allow moisture to pass through from the bottom water chambers but prevent the gunk from dropping into the lower portion of the incubation... easing the task of cleaning the incubator following a hatch.

CRACKED EGGS:

- ◆ It is generally a bad idea to incubate cracked eggs; it is also generally a good idea to discard any eggs that develop a crack during incubation. However, if an expensive or prized egg has or develops a crack, the cracked can be repaired using a small amount of un-perfumed wax. Use as little as possible and watch the egg during hatching as the seal may make hatching more difficult.

FERTILITY:

- ◆ The **fertility rate** is calculated by dividing the total number of eggs that show signs of development by the total number of eggs set. set 28 show development $\div 30 = 0.93$ or 93%.
- ◆ The recommended **rooster to hen ratio** is 1 rooster for every 8-10 hens. In some breeds such as rare bantams, that ratio may be lower – 1:3.
- ◆ A hen generally remains fertile for 10 days following the removal of a rooster. To guarantee that chicks are fathered by a specific rooster, hens should be separated from other roosters for three or four week.

HUMIDITY:

- ◆ Humidity is determined by surface area not water depth. To increase the humidity, increase the area water is exposed to the air either by using a wider pan or sponge.
- ◆ When adding water to an incubator, the water should be lukewarm – neither hot nor cold. Adding hot water will temporarily boost the humidity and may result in temporary uneven heating.
- ◆ During the final three days, placing warm wet kitchen sponges on top of the mesh will boost the humidity. Be sure all detergent is washed out of the sponges before using. Also be sure to carefully wash and scald sponges after each batch to prevent bacterial growth.
- ◆ To decrease humidity within an incubator, add uncooked dry rice to the incubator pan.
- ◆ If you have difficulty seeing the water in the water chambers, add a drop or two of food coloring. As the water level drops, the color will drop. It will lighten once again as you add more water.
- ◆ You can add water to the chambers underneath the mesh without opening the incubator. At lockdown, thread a small tube through a ventilation hole, through the mess, and into the chambers. Attach a children's medical syringe with the plunger removed to the tubing and then use the syringe as a funnel.

INCUBATION PERIODS:

	Chicken	Turkey	Duck	Muscovy	Goose	Guinea	Peafowl
Period in Days	21	28	28	35	30	28	28
Circulated Air Temp.	99.5	99.5	99.5	99.5	99.5	99.5	99.5
Still Air Temp.	101.5	101.5	101.5	101.5	101.5	101.5	101.5
Relative Humidity	45-50%	50%	55-60%	60%	60%	55-60%	55-60%
No Turning After	18	25	25	31	25	25	25

POWER OUTAGES:

- ◆ Power outages do occur and usually at the most inopportune time. Fortunately, an outage of 2-3 hours and a temperature drop in to the mid-80s will have little effect on embryos. Longer power outages may harm the embryos and a delayed hatch. Placing a blanket over your incubator will help reduce heat loss. Additionally, if you have access to non-electric heat source, such as natural gas, cranking up a space heater can reduce possible negative effects. Regardless of the length of the power outage, do not abandon the hatch; candling the eggs a few days later will help determine if any embryos died.

SEPARATING CHICKS AT HATCH:

- ◆ Using plastic canvas knitting sheets, construct cages for each group of eggs you wish to keep separate. The cages should be as large and tall as possible avoiding the heating or other incubator components. Each mini-cage must have a lid to prevent the hatchling from climbing over the side and into the next cage.

SEX DETERMINATION:

- ◆ Unlike in humans, the hen determines the sex of the chick by passing along either a W chromosome for females or a Z chromosome for males.
- ◆ Although not scientifically demonstrated, some hobbyists believe that round eggs produce females and pointy eggs produce males.
- ◆ Although not scientifically demonstrated, some hobbyists believe that lower incubation temperatures produce more females and higher incubation temperatures produce more produce males.
- ◆ Some specifically bred hybrids (breed mixes) produce chicks where males will be one color and females will be a different color; these hybrids are known as sex-links.

TEMPERATURE STABILITY:

- ◆ Full incubators will experience fewer temperature fluctuations than nearly empty ones. If you must incubate only a small number of eggs, add a heat sink – sealed water bottles or rocks. A heat sink will absorb excess heat during short spikes in temperature and release that heat during short dives.

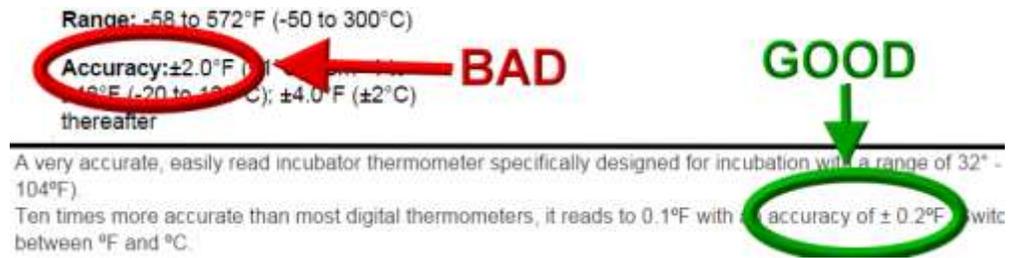


Incubation Thermometers

OBJECTIVE: Chickens should hatch on day 21. If they hatch early, then your temperature is too high. If they hatch later, then your temperature is too low. While early and late chicks may survive, they are not among the healthiest or vigorous. **It is important that you get your incubation temperature correct.**

INCUBATOR GAUGES: **Do Not Trust** the gauges that came with your incubator. Verify that both the temperature and humidity readings are correct with a calibrated thermometer and hygrometer. It is recommended that this verification be repeated periodically. If there is a reading difference between the incubator panel and the calibrated thermometer, trust the calibrated thermometer.

DIGITAL SENSITIVITY: **Most digital thermometers are inadequate for incubation.** While they may read to 0.1° F, they are only sensitive to 2.0° F – while the readout may display 99.5° F the temperature will range anywhere from 98.5° F to 100.5° F. Before purchasing a digital thermometer, read the packaging. If it does not specifically list an accuracy of $\pm 0.2^\circ\text{F}$, do not buy it...



CAUTION: All digital thermometers appear to be accurate but **most** are grossly inadequate for incubation. A digital thermometer **must be calibrated** and **must have a sensitivity** of no less than $\pm 0.2^\circ\text{F}$.

RESPONSE TIME: When the heating element comes on, the temperature will rise and continue to do so for a short time after the element switches off. Some digital thermo meters will incorrectly register this rise as a temperature spike and cause concern... “Why does my temperature seem to bounce all over the place?” Digital thermometers encase in plastic frequently continue to register this increase long after the air temperature has returned to normal. For best result, buy only digital thermometers with a probe type sensor where the probe can be slipped into one of the vent holes.



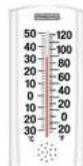
THERMOMETER TYPES

STEM



- PRO:** Slips thru vent
May be calibrated
- CON:** May be difficult to read
Not readable to 0.1°

RED, SPIRIT GLASS



- PRO:** Easily calibrated
Inexpensive
- CON:** Difficult to read
Not readable to 0.1°

DIGITAL PROBE



- PRO:** Slips thru vent
Easily to read
- CON:** Can be Expensive
Most not accurate $\pm 0.2^\circ$

DIGITAL



- PRO:** Easy to read
Inexpensive
- CON:** Cannot be calibrated
Most not accurate $\pm 0.2^\circ$

MERCURY THERMOMETERS: Silver mercury glass thermometers are the most accurate thermometers but are not readily available because of toxicity associated with mercury.

CALIBRATING A THERMOMETER

FREEZING POINT

1. Fill a glass with crushed ice cubes and cold water.
2. Stir the water and let sit for 3 minutes.
3. Stir again, then insert your thermometer into the glass, making sure not to touch the sides.
4. The temperature should read 32°F (0°C).
5. If it doesn't, loosen the glue holding the glass to the scale, move the glass up or down as needed.
6. Recheck accuracy and secure tube with a drop of glue.

BOILING POINT

1. Boil a pot of distilled water.
2. Once the water has reached a rolling boil, insert your thermometer, making sure not to touch the sides or bottom of the pot.
3. The temperature should read 212°F (100°C).
7. If it doesn't, loosen the glue holding the glass to the scale, move the glass up or down as needed.
4. Recheck accuracy and secure tube with a drop of glue.