

From Egg to Chick

A Guide for Successful Incubation and Brooding

This Guide has been written to provide knowledge about the incubation and brooding of chicks. We hope to increase the pleasure, satisfaction and fun derived from incubating and raising birds. We hope to provide information for the successful incubation and brooding of poultry for small flock producers.

There are a large number of reasons for failed hatches. Eggs may not be fertile to begin with. Fertile eggs may be improperly stored or handled, improperly turned or exposed to deficient sanitary practices. There may be improper temperature and humidity control. All these and other factors contribute to failed or reduced hatches. Even with proper handling, not all fertile eggs hatch. Following incubation, many factors contribute to successful brooding including proper nutrition, proper sanitation and disease control among others.

Because of the multitude of reasons for successful incubation and hatching, Brower assumes no liability for failed hatches or problems which develop after hatching. Also, with thousands of units in service starting in 1924, we know our incubators and controls have been used to hatch and/or brood every conceivable creature that starts life in a shell--as well as some that have never seen a shell. Chicks are highly complex living organisms and this Guide summarizes our thoughts and thoughts of others about how they develop and are born. When it comes to species other than birds--snakes, turtles and the like--please consult an expert in these areas. We do not represent that our equipment can be used with any species other than birds.

While the information in this Guide can be used with any equipment, Brower makes no representation that the information herein applies to equipment other than that manufactured by Brower.

EGG SELECTION AND CARE

Fertile eggs can be obtained from hatcheries, poultry breeding farms and specialty fertile egg suppliers. Look in your yellow pages, contact your Agricultural Extension service or contact Brower for good suppliers. Eggs sold in grocery stores are largely not fertile and cannot be used for incubation. Breeder selection management and nutrition play an important part in hatchability. However, storage conditions after you receive the eggs play a very important role. Here are some guidelines.

1. Eggs stored for one day will hatch better than fresh laid eggs placed immediately in an incubator. The storage of hatching eggs from one to five days generally results in maximum hatchability. A lot of commercial farms set eggs once a week.
2. Long term storage of eggs prior to incubation causes a significant loss of hatchability. The hatching percentage declines dramatically if eggs have been stored about 13 days or more. The only exception seems to be Chukar eggs which can be stored up to 28 days or so.

If you hold hatching eggs before they are set, keep them at about 55°F (12°C) and 75% relative humidity. The vegetable section of your refrigerator--if at the proper temperature--can be used to hold your eggs. Temperatures below 40°F (about 5°C) reduce hatchability. Storage at room temperature will reduce hatch. Most literature recommends storage with the small end of the egg down.

REMEMBER: STRONG FERTILE EGGS ARE MOST IMPORTANT.

FERTILITY TESTING

Although it is not necessary to test eggs for fertility, you can eliminate the eggs which are not going to hatch by doing so. It is also interesting to test since it is possible to see clearly the developing embryo. Testing is also referred to as candling.

Darken the room, hold the large end of the egg to a candling light. Look through the side of the egg and slowly turn it in your hand. What you will see depends mostly on the age of the embryo. It is difficult to see much development until the 4th or 5th day of incubation.

The first parts of the embryo which you will see by candling will be the head and eye. They will appear as a dark object. If the embryo is alive and circulation is established, the contents of the egg will have a pinkish color or cast. If the embryo is dead, the contents

will appear muddy or brownish. The live and growing embryo will eventually occupy all of the interior of the egg and will not transmit light. Thus, it will be impossible to see anything but the air cell at the end of the incubation period. Infertile eggs and early dead embryos can be detected readily because they appear clear.

Removing the eggs from the incubator for candling does little harm if you handle them gently. It may slow up development of the chick, though, depending upon how much the egg is cooled. Generally, if the eggs are removed from the incubator two or three times for a period of no more than 15 minutes each, such cooling will make little difference in the total incubation time required for hatching. On the other hand, if the eggs are cooled for several hours because of power failure or some other reason, hatching times may be delayed. Candle for proper humidity at the same time you test for fertility. See Humidity, page 2.

Before you handle eggs, wash your hands or wear gloves. Oil from your skin can clog egg pores and retard embryo development.

SANITIZING EGGS

Most commercial hatcheries sanitize their eggs. There are differences of opinions about how to sanitize eggs, if you feel they need to be. Some experts advocate washing and even lightly scrubbing eggs with soft brushes. Others feel that the most that should be done is dipping for a few seconds. Because of the varying opinions on sanitizing eggs, the following is an opinion of Brower and not necessarily a hard and fast recommendation. Accomplish sanitizing by dipping eggs in solution containing disinfectant that is just strong enough to kill bacteria and viruses. However, the disinfectant should not be so strong as to damage the embryos.

Mix the sanitizing solution according to the manufacturers' instruction. A recommended cleaning solution is Tex-Trol. Tex-Trol may be available at a local retail outlet. For the name of a retailer search for it online. If using Tex-Trol, mix one half ounce of concentrated disinfectant to one gallon of warm water. You can also use 1 ounce of Clorox to 2 gallons of water. The water should be 100 to 110 degrees Fahrenheit (37° to 44°C). If the egg is warmer than the solution, contamination can be pulled through the pores of the egg before the agent has a chance to neutralize any pathogens.. Submerge the eggs for one to three minutes with dirtier eggs left in solution longer than ones that essentially look clean. Allow the eggs to air dry at room temperature and store as described above--or set in your incubator. A soft paper tissue can be used to dry the eggs but don't rub the egg with a tissue or any material. Eggs have a natural protective cuticle that helps retard contamination. Rubbing removes the cuticle and can actually drive pathogens through the shell.

LOCATION OF YOUR INCUBATOR

We recommend locating your incubator in a room where the temperature ranges between 70°F (21°C) and 85°F (29°C). The room should be free from drafts and excessive variations in temperature. Your incubator should not be located near a source of carbon dioxide concentration such as from a gas heater. High concentrations of carbon dioxide can kill embryos. The room needs adequate oxygen intake and carbon dioxide exhaust. Do not place the incubator near windows where it could be exposed to the direct rays of sun. The sun's rays or excess heat from other sources can destroy embryos. Drafts could cause embryos to catch pneumonia. If you are going to incubate in an area where the room temperature is much colder than 70°F (21°C), you should consider ordering an insulated blanket which fits around the tray. Order Model TH198 Incubator Tray Blanket (reflective bubble pack insulation, 6 3/4" x 55 1/4"). With the blanket you can incubate with room temperatures down to about 55°F (13°C). Below 55°F (13°C) you will need to provide supplemental heat in the area of the incubator even if you are using a blanket. Your incubator should not be exposed to a great deal of vibration from vehicles or other machines. Basements tend to be a good place to incubate because of an acceptable temperature without a lot of variation and no exposure to sunlight. Normal light and color of the environment have minimal affect on hatchability.

TEMPERATURE

Your electronic control should be set at 99.5°F (37.5°C). Leave it there for the entire incubation period for all species listed below. Before placing eggs in your incubator, turn it on for at least 24 hours to verify a temperature of 99.5°F (37°C) by placing your thermometer on the turn rack. It's better to under-heat (you'll get a somewhat delayed hatch) than to over-heat.

EXPECTED INCUBATION AND HATCHING TIME - DAYS

Chicken and Bantam	21	Pigeon	17
Bobwhite Quail	23-24	Goose	28-34
Button Quail	16	Duck	28
Cortunix Quail	17-18	Muscovy Duck	35-37
Valley Quail	21-22	Guinea	28
Ring Neck Pheasant	23-24	Parakeet	18
Mongolian Pheasant	24-25	Parrots	28
Chukar Partridge	23-24	Dove	14
Turkey	28	Mynah	14
Peafowl	28-30	Finch	14
Grouse	25		

Many factors account for reduced, early or late hatches. Temperature can be a starting point for making adjustments. An adjustment of one or more degrees may correct problems you suspect are temperature related. If eggs hatch a day or more early, the temperature may be too high. On the next setting, operate one degree cooler. If eggs hatch a day or more late, the temperature may be too low. On the next setting, increase the temperature one degree.

There can be a fair amount of variance from one thermometer to the next. Don't use a human fever thermometer, as they usually read too high in an incubator environment. For any particular thermometer, several egg settings may be required to determine the best temperature.

AIR MOVEMENT

Brower's Model TH130 incubator has air movement by natural convection and by a standard equipped fan. Air is heated in the center tower and evenly billows from the top of the tower over the eggs. There is no forced draft or blast of air on any egg. This natural movement continues during the entire incubating period. Most table top incubators with circulating air have fans which operate only when the heating element is on. This causes a lot of variation in how eggs are subjected to air blast.

HUMIDITY

Incubating eggs do have a surprising tolerance for variations in humidity. However, you should observe the following. Nature has provided that eggs should dry out to some extent during incubation. See Exhibit A. This loss under good conditions will be about 11% of the original weight. Nature provides for an air bubble to form in the large end. This is necessary for the chick to be able to pip through the shell and peck off the cap. Excess humidity will cause this air pocket to be too small. The chick will not be able to pip through the shell above the area containing fluid and may well drown. The chick may also be over sized from excess fluids if the humidity is too high. On the other hand, insufficient humidity during incubation can cause the chick to stick to the shell and also contribute to a delayed hatch. It will not be able to turn as it attempts to peck off the cap.

EXHIBIT A



1
Fresh egg before incubating. Note small air bubble.

2
Excess Humidity

3
Insufficient Humidity

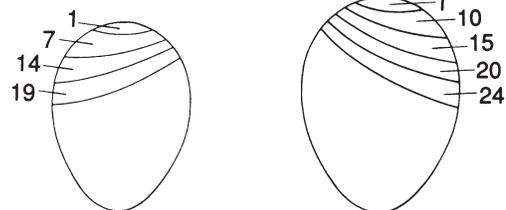
4
Egg incubated with correct humidity. Air bubble is the right size. Chick will pip above the dotted line.

Weather conditions affect relative humidity in the incubator. The amount of opening in the incubator also influences the level of humidity. The ideal moisture level is about 50 to 55% relative humidity (83°-87°F on a wet bulb thermometer) for the first 18 days and about 75% (90°-94° wet bulb) for the last 3 days. Some variations above or below the ideal level usually will not affect hatchability drastically. Some experienced producers spray goose and duck eggs twice weekly and at least three times during the last ten days. Use 110°F (43.3°C) water when spraying. Don't spray water into the tower. Humidity is controlled by adding water to the outside of the tray. Check and fill water ring twice a week. Be sure there is sufficient water during the last 3 days of incubation.

Please also note that you should use only distilled water. This will reduce the amount of mineral buildup in your incubator. When you fill, use warm water. Finally, do not let the eggs come in direct contact to the water. Eggs under incubation will give off a certain amount of moisture. The environment of your incubator does have an effect on how you manage humidity. An incubator operated in a very damp cellar or room with a lot of natural moisture, may require the addition of only a small amount of water. Remember to watch the air space in your egg. Candle just as you do when you test for fertility. If the air space is too large, provide more moisture. If the air space is too small, increase the ventilation (remove a plug in the cover) and do not add additional moisture.

At the end of the seventh day, the space should be no larger than a twenty-five cent piece. On the fourteenth day, there should be an air space no larger than a fifty cent piece. See Exhibit B.

EXHIBIT B



Chicken

Turkey

Size of the air cell on the 7th, 14th, and 19th days of incubation for chicken and on days as specified for turkey.

Check with Brower for availability of hygrometers and instruction for use for measuring humidity.

HYGIENE

ALWAYS START WITH A CLEAN INCUBATOR. Poor hygienic practices are a major reason for failed hatches. You may have done everything correctly but bacteria in your incubator can contribute to disease entering through the shells.

Birds can acquire disease through the shell and if they successfully hatch, those diseases can be spread to an entire flock. You increase your chances for contamination if you keep adding eggs to the incubator. Operate your incubator "all-in/all-out". With Brower's Top Hatch Incubator Models, the tray is removable and can be cleaned in an automatic dish washer. Use low heat and wash the cover and rack in the upper dishwasher rack if possible. Even after cleaning, we recommend the use of a disinfectant cleaner. One recommended product is Tek-Trol. Ammonia or Clorox and water can also be used. Wipe the tower clean using disinfectant.

Remember that a styrofoam incubator cannot be cleaned to the same extent that you can clean and sanitize Brower's Top Hatch incubator. Styrofoam pores can hide pathogens. Also, styrofoam incubator manufacturers' recommendations are to NOT scrub styrofoam as damage will occur.

SETTING THE EGGS

You are now ready to place the eggs. Warm eggs to room temperature. Eggs should be placed on their sides with the small end pointed slightly down. Do not over-crowd the eggs. The temperature inside your incubator will vary as the eggs become warm. However, you do not need to change the temperature of your control. It will adjust automatically according to conditions. Three days after setting

the eggs, remove one Ref. No. 1 Vent Plug.

TURNING OF EGGS

Egg turning is done for three reasons. First of all, turning reduces temperature gradients within the egg. Secondly, turning prevents embryos from sticking to the egg shell membranes during early incubation. Thirdly, and most importantly, egg turning is required to allow the proper utilization of growth nutrients in the inner white. If eggs are not turned, such nutrients cannot easily move to accessibility by the embryo. The embryo does emit wastes and those wastes are moved away from the embryo by turning--allowing the embryo to access the nutrients it needs for development. Brower has Australian research which proves conclusively -- at least in small hatches -- that the manner in which eggs are turned (orientation) has no impact on hatchability. The most popular small incubators in Europe all roll the eggs and European research confirms that hatch percentages between rolling and tilting eggs are statistically identical. When eggs are turned is the most important decision. The critical period is three to seven days. Eggs not turned in this period but at all other times have lower hatchability than when turned in the critical period of three to seven days.

Brower's Top Hatch Incubator Model TH130 comes with a rack designed for protected rolling of the egg. Thus, eggs roll back and forth and not continuously in one direction.

Try to place eggs of the same size and type in each section of the turning rack. **IF YOU HAVE BUT A FEW EGGS, PLACE THEM ALL IN AS FEW OF THE EIGHT SECTIONS OF THE TURN RACK AS POSSIBLE. ONE OR TWO EGGS PLACED IN ONE SECTION ZONE MAY NOT BE SUFFICIENTLY TURNED.** Stop turning eggs 3 days before the hatch. Do this by lifting the tray slightly and rotating the tray so that the motor crank cannot engage the lug on the bottom of the tray. This will prevent turning but the turning rack can remain in place.

EMERGENCE

If you so desire, you can candle your eggs at intervals as discussed above. Stop turning eggs at least three days before hatching, and don't open the incubator top until the chicks start to emerge. Chicks, for example, will start to pip the shell around the nineteenth day. All chicks which are going to hatch should be out of their shells by the twenty-first to twenty-second day (with chicken). The head of the chick develops at the large end of the egg. Between the fifteen and sixteenth days, the chick orients itself so that its head is near the air cell at the large end of the egg. Just before the chick is ready to attempt to make its way out of the shell, its neck acquires a double bend so that its beak is under its right wing and pointing at the air cell. About the nineteenth day, the chick thrusts its head forward and its beak quickly breaks the inner shell membrane. When exposed to the air in the cell, the chick's lungs begin to function. Complete breathing by the lungs usually does not occur until the twentieth day of incubation (in the case of chickens). A chick will peck at a shell thousands of times. Finally, the young bird pips its way through the shell and begins to breathe air from the outside. When the shell has been pipped, the chick will rest for several hours. After this resting stage is completed, the chick begins to turn slowly inside the egg. As it turns, the cutting edge of the chick's beak, the chick's "tooth", continues to chip away. It may take another three to five hours before the chick breaks free from the shell when it is still wet and panting. Chicks are exhausted from this emergence. After a few days, the tooth (a sharp projection from the end of the beak) disappears. Chicks can be removed from the incubator when they are completely dry. They may be left in the incubator for up to 24 hours or so. Remove chicks from the incubator just once a day as to avoid escape of warm and moist air. Often eggs hatch late so you may want to wait beyond the normal incubation period for species as specified on page 2. During the last 3 days of hatch, if water drops form on the cover, remove one vent plug. As chicks emerge, remove one additional plug. If water continues to form, remove additional plugs. Be sure to replace plugs for the next setting of eggs.

Do not be in a hurry to take your chicks out of the incubator. The yolk of the egg is drawn through the navel into the stomach of the baby bird before it hatches. This provides nourishment for the period

of time during which the bird hatches, fluffs out, gains strength and becomes active enough to go out and seek food. It is generally best to take the chicks out of the incubator as soon as they are dry. Avoid chilling wet chicks.

BROODING

Brooding is the period of time during which the environment around the chicks is controlled to allow the chicks to be conditioned to their new natural environment. Heat and the control of the heat and the manner in which the birds are integrated with the source of heat can often be a main factor determining the percentage of mortality in baby chicks.

During incubation, the chick has been in a closely controlled temperature. After hatching and going into brooding, birds are exposed to a lot greater variation in temperature. Chicks need to gradually increase their tolerance for temperature variation and lower temperature. Start with a brooding temperature of 95°F (about 35°C). Use Brower's Model CQB20 Brooder. Reduce the temperature by approximately 5°F (2.8°C) each week to a temperature of about 70°F (21°C) until they are nearly grown. In warm weather, heat is usually not necessary after the fourth week.

Some species of birds develop a faster tolerance to temperature fluctuations and require less brooding. A strong indication of this adjustment to heat variation can be judged by observing how the birds vary their range of distance from the heat source. Make sure that there is not a supplemental source of heat which may cause the brooder to over-heat during the day (such as from direct sunlight). Over-heated birds are poorly feathered. During the first few days, chicks may sleep in groups, directly next to the heater. As their tolerance increases, they will tend to rest further away from the heat source and in separate groups. Some species need a temperature of about 70°F (21°C) until they are grown.

Chicks of different ages generally should not be brooded together. The younger smaller birds may suffer.

FOOD AND WATER

Feed and water chicks as soon as they are removed from the incubator. Check with a feed dealer for proper feed for the species you have hatched.

Chicks readily locate feed and water by themselves. If birds are not feeding and drinking, they may be ailing from one of several causes. There may be improper regulation of the brooder heat, the birds may be sick, the birds may have been blinded by bright lights. Also, some birds are albinos who have very poor eye sight or are totally blind. That's why colored lights are preferred during brooding. It is true that chicks with a mother hen learn to eat by example. However, chicks naturally find their way to the feeder and drinker. The more aggressive and inquisitive ones will eat and drink first and the balance of the flock will imitate them.

Baby chicks have a tendency to drown themselves if they are afforded the opportunity. Since chicks are newly emerged from a fluid environment inside the egg, there is an instinct to go to water. After 3 or 4 days, this urge to become emerged in the water is reduced and after a week it disappears. You can place marbles to keep the birds from getting into the water, but place them so they can still drink. Brower has several models of founts including drown proof bases.

We have provided you with the basics of incubation, hatching and brooding. Several books are available which go into more detail. These books can be obtained from your extension service or from numerous mail order poultry firms or general equipment catalogs. Above all, experience is the top factor in successful hatching. Please let us know how we can help you.

INCUBATION TROUBLE-SHOOTING CHART

Symptoms	Probable Causes	Suggestions
Many clear eggs Showing no development. Infertiles.	<ol style="list-style-type: none"> 1. Too many or too few males. 2. Seasonal decline in fertility in late summer and fall. 3. Males undernourished as evidenced by poor fleshing and shrinking of comb and wattles. 4. Interference of males during mating. 5. Frozen comb and wattles during cold weather. 6. Males too old. 7. Preferential mating - in pen matings. 8. Sterility of males - usually in pen mating. 9. Eggs held too long. Eggs chilled by holding at too low a temperature. 	<ol style="list-style-type: none"> 1. Use 1 male to 15-25 females with Leghorns and 1 male to 12-20 females with heavy breeds. Use 1 male to 10-12 females for turkeys. 2. Use early hatched cockerels 6-9 months of age depending on rate of sexual maturity. 3. Replace underweight males with vigorous males in good condition. Provide feeders on roosts. Dub Leghorn males. 4. Do not use too many males. Raise males together. Provide temporary partitioning or blinds in large pens when breeders are confined. 5. Provide comfortable housing and use proper kind of drinking fountains. Dub males in cold climates. 6. Use cockerels instead of old males unless the latter are proven valuable breeders. 7. Artificially inseminate infertile hens or put with another male in different pen. 8. Replace with another male. 9. Set eggs within 7 to 10 days after laying. Hold eggs where the temperature is about 55°F and about 75% relative humidity.
Blood rings.	<ol style="list-style-type: none"> 10. Improper temperatures. 11. Improper disinfecting. 12. Holding eggs at temperatures above 80°F before incubation, 	<ol style="list-style-type: none"> 10. Check accuracy of thermometer. Check control, heat source, current supply. Check operating temperature against manufacturer's instructions. 11. Use Tex-trol or other disinfectant according to recommendations. 12. Hatching eggs should be held at about 55°F.
Many dead germs.	<ol style="list-style-type: none"> 13. Temperature too high or low. 14. Improper turning of eggs. 15. Breeding (low hatchability inherited). 16. Improper ventilation, insufficient oxygen. 17. Pullorum disease or other salmonellosis. 	<ol style="list-style-type: none"> 13. See suggestions (10) above. 14. Turn at least 3 times, preferably 5 or more in 24 hours. 15. Avoid close inbreeding. 16. Increase ventilation of incubator and incubator rooms; avoid drafts. Add oxygen at high altitudes. 17. Use eggs from disease-free sources only.
Pipped eggs not hatching.	<ol style="list-style-type: none"> 18. Insufficient moisture. 	<ol style="list-style-type: none"> 18. Increase evaporating surface for moisture or increase sprays. Chickens: first 18 days, wetbulb 83°F - 87°F; 3 day hatching period, 90°F - 94°F.
Hatching too early, too late. Sickly hatch.	<ol style="list-style-type: none"> 19. Too high temperature. 20. Too low temperature. 21. Probably too high temperature. 	<ol style="list-style-type: none"> 19-21. See (10) above. For all three: check temperature at maximum or when current actually goes off. During hatching period check temperature after current goes off to see if it increases further.
Malformed chicks. Spraddlers.	<ol style="list-style-type: none"> 22. Temperature too high. 23. Moisture too low 24. Improper turning or setting. 25. Hatching trays too smooth 	<ol style="list-style-type: none"> 22. See (10) above. 23. See (18) above. 24. See (14) above. Set eggs large end up. 25. Use trays with wire or crinoline on bottom.
Abnormal chicks. Weak or small chicks. Labored breathing. Large, soft bodied, mushy chicks. Dead on trays, bad odor.	<ol style="list-style-type: none"> 26. Overheating in hatching unit. 27. Small eggs 28. Insufficient moisture 29. Too much fumigant. Respiratory disease (bronchitis or Newcastle). 30. Low average temperature. 31. Poor ventilation. 32. Navel infection (omphalitis) in incubator. 	<ol style="list-style-type: none"> 26. See (10) above. 27. Set only standard or larger size eggs. 28. See (18) above. 29. Check with nearest disease laboratory. 30. See (10) above. 31. See (16) above. 32. Carefully clean and fumigate incubator between hatches.
Rough Navels.	<ol style="list-style-type: none"> 33. High temperature or wide temperature variations. 	<ol style="list-style-type: none"> 33. See (10) above.
Hatching too late or not uniformly.	<ol style="list-style-type: none"> 34. Old eggs and eggs of different ages. 	<ol style="list-style-type: none"> 34. Set eggs at least once each week.

BROODING TROUBLE-SHOOTING CHART

Symptoms	Probable Causes	Suggestions
Watery eyes Running nostrils	<ol style="list-style-type: none"> 1. Overheating of birds. 2. Unventilated building which has been heated by mid-day sun. 	<ol style="list-style-type: none"> 1. Medication.
Legs stretched out behind the bird.	<ol style="list-style-type: none"> 1. Piled on by other birds.. (Inadequate heat can cause piling) Extreme heat and prolonged stress. 	<ol style="list-style-type: none"> 1. Medication.
Spraddled legs.	<ol style="list-style-type: none"> 1. Putting birds on smooth, hard floors before they've had a chance to develop. 	<ol style="list-style-type: none"> 1. There is no cure for spraddled legs. Prevent by using rough fabric or litter.
Bad feathering and pecking of feathers.	<ol style="list-style-type: none"> 1. Over crowding and heating. 	<ol style="list-style-type: none"> 1. Use a red pilot bulb in brooder. 2. Use high protein feed. 3. Segregate injured birds until healed. 4. Commercially available red ointments can be used to deter pecking, promote healing.
Cementations of Toes.	<ol style="list-style-type: none"> 1. Manure accumulation on toes. 	<ol style="list-style-type: none"> 1. Use Browsers Brooder -- Model CQB20. 2. If using a bulb brooder, use litter (saw dust, shavings).

