Foolproof Requeening

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Introduction

What kind of success have you had in requeening? How would you like to improve your chances to 100% every time? Read on. While foolproof requeening may be more labor intensive than what you're currently doing, it is not only possible, I guarantee it! And since the queen carries *all* the genetic material for the entire hive (and you probably spent a lot of money on her), why take chances? In this article I'll review some important honey bee biology to help you understand the process of requeening. Then, I'll go over a few pieces of requeening equipment I like to use, tips on removing attendant bees and how to find your old queen, and then give you two methods of requeening. Finally I'll discuss a way that you can merge the two methods to make requeening more colonies more efficient. But first, just a little information about queens themselves.

Queen Basics

Of all the decisions you make on behalf of your honey bee colonies, choosing a good queen is probably the most critical. First, do you need to requeen? Some beekeepers requeen every year. But in most colonies that aren't over-stressed (by chemical treatments or lots of travel for pollination contracts), well-bred queens should last two or even three years. And if you have enough quality drones within a 4 or 5 mile radius from your apiary, why not just let the colony supersede its queen after the honey flow? Many times, a home-grown queen will outperform a purchased one. If you do wish to purchase a queen, be a discerning consumer. Does your queen breeder offer queens that have been raised in a chemical-free zone? Do they offer genetic diversity? Or have they inbred the same stock year after year? Personally, I use 4 - 6 purchased queens of different races from three different local suppliers along with 2 - 4 "survivor" queens (from long-standing feral colonies) and about 4 queens I have reared myself in my small-scale operation of 12 hives.

In addition, the timing of replacing your queens is an important consideration. I like to requeen in late summer, which is after the last honey flow and before the fall broodnest expansion that begins in mid August. That broodnest expansion is absolutely critical to the over-winter survival of your colony. Thus, an advantage of late requeening is that it provides a vigorous young queen the following spring, which is very unlikely to swarm, and yet build up quickly enough to provide a lot of foragers for an early honey flow. Queens can be more available in the late summer than during the early spring "rush" too. The disadvantages of late requeening are that colonies are stronger and more defensive (and robbing is more common) and the process isn't quite as easy or as much fun. There are a lot more bees to search through, the workers aren't nearly as accepting of a new queen, and their temperament isn't nearly as nice as during that light early spring flow. Regarding acceptance, the "hurdle" you must overcome when requeening is balling.

Figure 1. Honey bees balling a bumblebee intruder on the entrance board

Requeening Biology

Requeening is probably the most serious colony manipulation you will ever perform. There is a lot more to it than just removing one queen and adding another 24 hours later. After a direct release, worker bees will frequently ball a foreign queen, much like they do another insect intruder. Figure 1 shows guard bees balling a bumble bee on the entrance board of a hive. When balling, hundreds of workers grab onto appendages, biting and stinging the intruder, but more effectively kill the victim by overheating it.

Remember that honey bees live in the dark and are highly dependent on smell to direct their behavior. They learn the smell of the hive and their own queen's particular mix of pheromones as young nurse bees and become much more discriminating to foreign smells as they become guards and foragers. Guards hang out at the front entrance and foragers live outside the broodnest when they aren't in the field. These *older bees* that are solely responsible for balling new queens *are rarely* allowed *in the broodnest*. The young nurse bees that stay in the broodnest are much more accepting of new queens than their older sisters. Therefore, requeening a strong hive without nurse bees is destined to fail. The most extreme example of this - the laying worker hive - is covered as a separate topic in the sidebar. When requeening, two simple things will markedly improve your success: 1) Place your new queen smack dab in the middle of the broodnest, and 2) Get rid of as many foragers as possible beforehand. I've even seen guard bees ball their very own queen

when she was removed from the brood nest and immediately placed onto the entrance board (I don't suggest you repeat this experiment)!

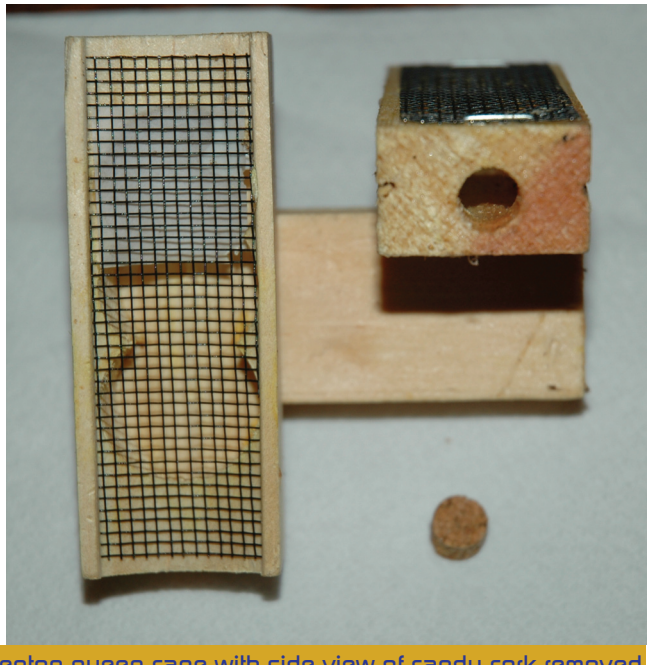
When a colony becomes queenless, as during the requeening process, it will frequently prefer to rear its own replacement rather than accept the new queen you've purchased. Recall that fertilized eggs hatch into larvae on day 3 (assuming they were laid on day 0). On days 4 and 5, juvenile hormone levels skyrocket in those very early larvae that are destined to become new queens. This hormone - and the subsequent influence it exerts on queen development - is entirely dependent on larval nutrition (royal jelly). Once a larva is past day 5 (that is, over 2 days as a larva), it is too old to be reared into a good quality queen. Its nutrition has basically destined it to become a worker by that point. This is the rationale behind the 5-day delay in release of the new queen in the requeening techniques that follow.

Requeening Equipment, etc.

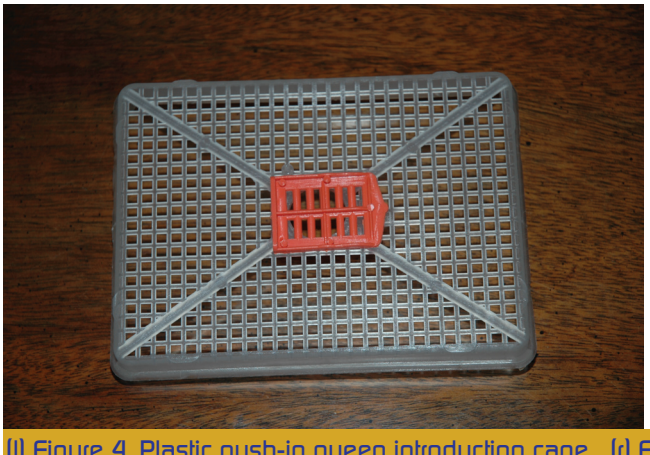
There are two commonly used queen cages in which your queen can arrive. Each has a loading hole which is closed by either a plastic flap (plastic JzBz cage - Figure 2) or cork (wooden Benton cage – Figure 3), and each has a queen candy plug which allows the bees access to the queen (by way of eating through the candy). You can prevent this access to the queen via the candy plug by temporarily closing it with a plastic cap, cork, or a piece of duct tape. Since queens can't feed themselves, your new queen will come with a few attendant bees in the queen cage with her. Sometimes one or two of the attendants have died. That is okay as long as the queen is still healthy.

Another useful piece of requeening equipment is a push-in introduction cage. Plastic versions can be purchased (Figure 4), but I much prefer the home-made 1/8" wire mesh type (Figure 5). The wire seems to penetrate the comb better than the plastic and allow slower access by the bees chewing a tunnel underneath it. The dimensions of my home-made wire-mesh types are 4" x 6" x ¾". A block of wood that is 4" x 6" x 1" and wire snips facilitate the folding and corner crimping that is necessary to make your own from a flat rectangular piece of 1/8" wire mesh that starts out 6" x 8". Either of these push-in cages is best used on plastic-backed foundation as they can destroy comb that is only wax-based if you aren't careful about the way it's placed. Frequently, a frame will need to be removed in order to make enough space for the introduction cage.

A queening rim is a ¾" x ¾" rectangular rim made to the dimensions of your hive that adds space inside the broodnest for the queen cage. A queening rim facilitates requeening, but hanging or wedging the queen cage between frames works well too. Remember, whether you use a push-in introduction cage or a queening rim or you



(l) Figure 2. JzBz queen cage and plastic cap (r) Figure 3. Benton queen cage with side view of candy cork removed



(l) Figure 4. Plastic push-in queen introduction cage (r) Figure 5. Edge of wire-mesh push-in queen introduction cage with queen inside

wedge or hang the queen cage between frames, the new queen goes inside the very center of the broodnest! Not on top of capped honey (where the foragers hang out)! If you do chose to hang or wedge the cage, place the candy end up so that any dead attendants don't block the queen's egress.

A Snelgrove double screen board is another necessary piece of equipment for foolproof or double-brood requeening. It is a fairly thin board with two screens that are separated by a large enough space (3/8") to prevent the bees on one side from communicating with the bees on the other. The screens allow the transference of smells between the two portions of the hive it separates, however. A double screen board also has multiple small entrances to either the top side or bottom side of the screens that can be individually opened or closed (Figure 6).

If there isn't a nectar flow, I like to feed colonies that are being requeened light sugar syrup during the process, but I may not in the late summer because of the risk of inciting robbing behavior. I also significantly minimize the amount of smoke I use once the new queen has been introduced. Some smoke may be needed before she's been accepted, but I don't use any smoke for a few weeks after she's been accepted. Before we discuss how to find your unmarked old queen and the two requeening techniques, there's just one more optional technique that will increase your queen acceptance rate a little.

Attendant Removal

If you feel confident enough, remove the queen's attendant bees from the queen cage just before you introduce her (not when she first arrives). I do this in an enclosed room with a window or light for the queen to fly to in case she escapes. The simplest way to remove the attendants is to temporarily remove the cork or plastic flap from the loading or non-candy hole, put your finger over the hole, and let the attendants fly up and out, one by one, replacing your finger every time the queen comes up toward the hole. Then replace the cork or plastic flap.

Finding the Old Queen

In a typical broodnest inspection, you do not need to find the queen. If you have singly-laid eggs at the bottoms of individual cells in the broodnest, you have one! You must find her to replace her, however. And if she isn't marked, finding her can be challenging.

When looking for the queen, pattern recognition skills come in handy. She is most likely in the broodnest. Have an empty hive body or frame perch to put the first few already-scanned frames in and start scanning the upper brood chamber. Remove one frame at a time starting at the edge farthest from the broodnest. Scan both sides of each frame twice and then put it into the empty hive body. Read on for scanning techniques. Once three or four frames have been removed, you may just scoot the frames over to the empty side of the chamber once they've been scanned, leaving a big space between already-scanned and yet-to-be scanned frames. Once the entire chamber has been scanned, replace the previously removed frames in the same orientation they were in, and go down to the next brood chamber.

Scan frames full of honey very quickly, and concentrate most of your time on those frames with eggs and emerging capped brood or empty cells within the broodnest. The first frame scan (on each side) should only take about 3 – 4 seconds. Do it in an almost 'out of focus' fashion – quickly from one side to the other. Then flip it over and repeat it on the other side. With this first scan, you are merely looking for something *different*; *don't* look at each individual bee. The second scan (again on each side, and this time making sure to look at the bottom and edges too) is much more thorough, and may take 20 – 30 seconds.

The queen looks *and* acts differently from the other bees. She has a long pointed abdomen, which she may drag on the comb. She holds her wings folded over her back, not out slightly like workers do. Her wings appear shorter because her abdomen is longer. Her legs are longer, and she walks (or runs) on the comb; she doesn't fly or even vibrate/fan her wings. She has a bald, dark thorax with no hair. She is not fat like drones and doesn't have big eyes like they do. Her retinue nurse bees may surround her, all facing her in a circle, licking her and feeding her. The workers will typically part (like the Red Sea for Moses) as she walks along. She doesn't like light, so she will quickly go to the side of the frame that you aren't looking at! And she may have her abdomen down in a cell laying an egg when you first scan for her. This is the reason for two scans.

Once you find her, scoop her up with a queen catcher or gently set that frame to the side, outside the hive (so she can't move to another frame). You can determine her fate later, depending on the requeening method you are using. Once you're sure you no longer need her, squish her thorax.

After looking through all the chambers thoroughly, if you still haven't found the queen, place a queen excluder between each brood chamber and come back in 4 days. She'll be in the only one with eggs. Coming back another day seems to help too, if not with your success, at least with

Laying Worker Colonies and Their Management

When a colony survives a queen loss for many weeks and does not successfully replace the queen, queen mandibular pheromone (QMP or queen substance) production *and* brood pheromone levels are both low. This allows the ovaries of many of the larger (infertile) workers to develop and these workers begin laying eggs. There will be multiple eggs on the side walls of each cell because the laying worker's abdomens aren't long enough to reach the bottoms of the cells and they also can't detect that an egg has already been laid there. Their unfertilized eggs will develop into drones only, despite the fact that they are developing in worker-sized cells. The combined QMP output from all the laying workers is sufficient to fool the colony into believing that they have a queen. Finding all of the laying workers is impossible. Simple requeening of a laying worker hive *will consistently fail*, because: 1. There are no young accepting nurse bees present (only old, unaccepting foragers), and 2. The colony thinks they have a queen.

The best way to manage this situation is to combine this colony with a queenright colony using the newspaper method. Move the laying worker hive to the strong one's location, and place the *STRONG*, queen-right colony *ON TOP* of the laying worker colony with 2 sheets of newspaper in between them. Make sure the newly combined hive is located where the strong hive used to be. Provide the combined hive with only a lower entrance so that the upper foragers have to traverse the lower weak hive after they chew away the newspaper. The queen will move down and take over the old lower broodnest in time. A few weeks later, after the queen has moved down into the old broodnest, you can split out a portion of the combined colony to "recreate" your old colony just as if you were creating a nuc in the double brood method. You can then either have the nuc raise their own queen or provide them with a purchased queen.

your attitude! When requeening multiple hives, I like to use the delayed release technique with a push-in introduction cage in those colonies in which I find the queen easily and the double brood technique in those in which I can't.

Delayed Release Requeening

While the delayed release technique isn't foolproof, it is much more successful than simply putting the cage into a dequeened hive and letting the bees release her (and possibly ball her) within a day or so. It's easier than the double brood technique, but it interrupts the brood cycle, which sometimes creates another problem, which we'll discuss later.

On the day the new queen arrives, find and remove the old queen from the hive. Place a small drop of water on the screen of the queen cage, and store the new queen in a cool dark place overnight. The next day, introduce the new queen with a queening rim, ensuring that the candy end of the queen cage is closed (see Requeening Equipment) for 5 - 7 days. Return to the colony after 5 - 7 days and determine the bee's reaction to her. Are there a lot of bees completely covering the cage with some of them aggressively biting or trying to sting the cage (Figure 7)? Or are there fewer bees walking across the cage in a more relaxed manner with a few of them licking her and trying to feed her through the screen? If the bees have not accepted her, shake the clinging bees off of every frame, one by one, carefully inspecting for and removing *all* the queen cells that have developed. Now that 6 days have passed, the remaining larvae are too old for the bees to rear their own replacement queen (see Requeening Biology). Return again in about 5 more days, leaving the new queen caged the whole time. If the bees have accepted her, developing queen cells are unlikely, but I still look for them, just in case, and remove any that I see. Once she's been accepted, remove the plug over the candy end of the queen cage. You may also spritz the colony and the queen cage with light sugar syrup containing a hint of vanilla extract if you wish. Once you've allowed access to the candy, you may reinspect and ensure her release after 2 more days. She'll start laying eggs within 3 days of her release. Recheck the colony without smoke for eggs *and* supersedure cells in about a week. This is the problem I alluded to earlier. Sometimes the brood nest interruption caused by the delay makes the bees a little nervous about the queen's egg-laying ability and they will try to supersede her once she's laid some eggs (what I call provisional acceptance). Just cutting those cells out once and giving time for more brood pheromone production (from her own brood) will typically allow her to be accepted long-term.

A good alternative to using the queen cage and cutting out queen cells is to release the new queen underneath a push-in introduction cage. The day that you find and remove the old queen, find a frame (preferably with plastic foundation) with a large area of *only* emerging, capped brood and empty cells (no open brood or eggs!). Gently remove as many nurse bees as possible from that area and push the cage firmly onto it so that about ¼" of the wire penetrates the comb (Figure 8) and replace the frame in the middle of the broodnest. You may need to remove an outside honey frame to make space for the cage. When you return 24 hours later, remove all the remaining bees from within the cage before releasing the new queen underneath the push-in introduction cage. Return in another week. Once the brood has emerged from within the push-in cage, the new queen will have been accepted by those newly emerged nurse bees, *and* laid eggs into the empty cells. Ensure there is not a lot of clinging and biting at the cage. If not, you may remove the cage again and let her out (if the bees haven't already dug a tunnel to her under the wax).

Double Brood (Foolproof) Requeening

Place a small drop of water on the screen, and store the new queen in a cool dark place for 2 nights. The day she arrives, generate a temporary 'nuc' using the upper brood chamber of the hive to be requeened by arranging at least 3 frames of (mostly emerging, capped) brood in the center, then empty drawn comb outside them, then a frame of nectar and a pollen-laden frame on either end. While you're making this up, shake *all* the adult bees (including the queen, which does not need to be located yet) off each frame into the bottom brood chamber. When you reconstruct the hive, put a queen excluder on top of the bottom brood chamber and the nurse bees will crawl up into the upper nuc overnight, but the queen will be incarcerated in the lower chamber. The next day, place the upper nuc onto an entrance-reduced double screen board (which serves as a temporary bottom board), and supply it with a queening rim, another inner cover and another top. Move the nuc to a new location near the parent hive. Open only a single back or side upper entrance on the double screen board and consider feeding the nuc light sugar syrup (if it's not robbing season).

Remove the queen excluder from the parent hive and replace its inner cover and top. Any transferred foragers will fly out of the nuc and back into the parent hive, leaving your nuc with nothing but nice young nurse bees. Introduce the new queen (without a cork or cover over the candy end this time) to the nuc after 24 more hours and watch the bees' reaction. Recheck the nuc in 3 – 5 days with no smoke and ensure her release. Even though she should have been accepted, it takes a weak nuc much longer than a strong hive to chew through the candy, so you may need to let her out yourself. Remove the queening rim and place the nuc back on top of the parent hive *with* the double screen board between them for 4 – 7 more days. At that time, close the previously open upper rear or side entrance on the double screen board and instead open the front entrances to both the upper and lower chambers on it (Figure 6). This allows a few foragers to traverse between the two colonies and the parent colony to get used to the new queen's smell.

Once you are sure the new queen is laying, remove the old queen from the lower chamber. Remove the double screen board and replace it with two sheets of newspaper 24 hours after removing the old queen. The new queen will march down and take over the old queen's brood nest. Obviously, if at any point the requeening fails, you still have your old queen. This is what makes it foolproof. The other advantage to this technique is that rather than a brood cycle interruption, you have two queens laying eggs simultaneously for one or two weeks, right during the fall broodnest expansion.

Figure 6. Edge of double screen board with upper and lower entrances open

Figure 7. Workers rejecting a new queen in a JzBz cage with plastic cap still on

Merging the Two Techniques

Finally, merging the two techniques lends some efficiency to larger scale requeening efforts. Just take queen excluders and push-in introduction cages to the apiary the day your queens arrive. Look for old queens in every hive to be requeened. If the old queen is easily found, remove her and place a push-in cage over some emerging capped brood (I also mark the frame and the outside of the brood chamber with a thumbtack so it's easy to find) and begin the delayed introduction the following day. If she's not found, proceed to the double brood technique by rearranging frames, shaking bees, and inserting the queen excluder. Remember how many of each type you've prepared so you'll know how many double screen boards and queening rims, extra inner covers and tops to bring with your queens in a day or two. By merging the two techniques, the old queens of the double brood method can still be used as 'backups' should either of the methods fail, so you shouldn't have any queenless colonies before winter!

Figure 8. Wire-Mesh push-in queen introduction cage on section of capped brood