

## **Efficient Key Rebushing** using the two-caul method

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Properly bushed keys are essential to good piano performance. They provide the foundation that allows accurate key leveling & spacing, and lend a solid and secure feel to the action. Key rebushing has traditionally been considered a tedious job. However, with the right methods, materials, and tools it can be a simple job yielding consistent, quality results.

### **The six components of quality key bushings.....**

- ▶ **Proper cloth:** Use only high quality, dense bushing cloth. Usually identified by its white center, the density and smooth finish allows the bushings to fit the keypins with minimal clearance and friction. The density also prevents glue from penetrating too far into the cloth, hardening it and leading to noise.
- ▶ **Properly prepared mortises:** Clean and uniformly sized.
- ▶ **Correct cloth depth:** The cloth should extend approx. 3/16" into the mortise. If too deep there will be excess drag on the pin and difficulty easing keys; if too shallow, wear is accelerated.
- ▶ **Correct type and amount of glue:** Hot hide glue is the best for several reasons. It is reversible (bushings can be easily removed with moisture in the future); it gels quickly upon cooling, preventing excess penetration into the cloth, and this gelling time can be adjusted; it sets up hard and contains water, and thus has sizing properties (see next).
- ▶ **Accurate sizing:** By using bushing cauls accurately made to correspond to the size of the keypins, a quality bushing cloth, and hot hide glue, the bushings are molded into the correct shape and size as the glue hardens and the moisture leaves the glue joint. This greatly reduces the need for key easing, preserving the keys and yielding a more stable job. Job time is also reduced.
- ▶ **Keypin condition:** Pins must be free of rust, nicks, and scratches. They should be well polished and sprayed with a dry teflon lubricant (never petroleum or oily liquids). Suitable products are:
  - Elmers Slide-All, available from most hardware stores
  - McLube 1725 or TFL-50 Dry Lube, both available from Schaff Piano Supply Co. and Pianotek Supply Co.

### **Procedures.....**

**1. Measure keypins:** Measure several front and balance rail pins with a micrometer so you will know what size bushing cauls to use. Typical sizes for common piano brands are shown in the table below; exceptions occur, however, so *always measure the pins and choose caul sizes accordingly.*

<b>Key Pin Sizes For Some Common Pianos</b>	<b>Balance Rail</b>	<b>Front Rail</b>
Most American pianos, incl. 1960-83 Steinway	.146"	.146"
Pre-1960 Steinway	.162"	.146"
Various pianos using German Kluge keyboards	.146"	.131"
Various pianos using German Renner keyboards	.146"	.125" or .129"
Old American Piano Co. (Chickering, Knabe, Vose, etc.)	.087"	.146"
Some pre-1920's Knabe	.152"	.152"
Yamaha, Young Chang, Herrburger Brooks (Kimball)	.137"	.125"
Kawai	.146"	.133"

**2. Clamp the keys together:** You will be able to work most efficiently if the keys are clamped together in a freestanding unit, so both your hands are free to do the work. Our [key clamps](#) consisting of two of the units pictured here, each holding 44 keys.

Note that when the keys are turned over, both sharps and naturals rest on the bench top so the front mortises of all keys are supported at one level. This makes it simple to work on all keys at once.

The keys can remain in the clamps through the entire process, from removal of the old bushings through installation of the new.



**3. [Remove the old bushings:](#)** Clean any dust from the keys with a brush and vacuum or compressed air; this will minimize water staining of the wood and aid in moisture penetration of the old cloth. Depending upon the type of glue present and the condition of the keys, there are various methods of bushing removal:

*Typical older keys, bushings glued in with hide glue and balance rail holes need sizing:* Pre-soak the old bushings first, by quickly dabbing each with a brush dipped in a solution of 1 cup water & 1 tsp. wallpaper remover. Then set a plastic travel steam iron on the keys; steam comes out of holes in the bottom of this "iron" and quickly loosens the old bushings. Usually you can slide the steamer ahead as fast as you can lift out the old bushings with tweezers. The steam will also close up the worn balance pin holes, which will require easing later on. These small plastic "irons" are often found in second-hand stores (look for the Osrow Steamstress or equivalent) and fabric stores.

*Keys where the original cloth was glued in with white glue, and keys which do not need the balance holes sized down:* White glue also yields to steam, but more slowly. In order to avoid damaging the keys by over-steaming, it is best to pre-soak more thoroughly using small felt wedges soaked in your water/wallpaper remover solution. Cut the wedges from hammer felt scraps (available from supply houses). Plug one wedge into each mortise, wait 1/2 hr. or more, then steam out using an "electric key bushing remover" (soldering pencil with a metal key bushing caul on the end). This device creates the steam within the bushing cloth itself, loosening them easily without steaming the key wood excessively. You can easily make one by drilling a hole in the end of an aluminum or brass bushing caul to fit the tip of a soldering pencil, or purchase from Schaff Piano Supply item #909.

**4. [Prepare mortises:](#)** Ideally the mortises will be smooth, free of splinters, and uniform in size. Some mortises will be fine after bushing removal and will need no further preparation. However in general, mortise wood of softer keys will be moisture-swollen and rough, with size variation from key to key. You can make a major improvement in consistency by using our mortise sizing cauls to size the mortises uniformly as they dry. Just insert one into each mortise as the old bushings are removed (or immediately after), and leave in place until the keys dry. The mortises will turn out uniform in size and very smooth. You will then be able to choose a cloth thickness that fits all mortises equally well, yielding the most consistent bushings possible. Bushing stability is also improved because the mortise wood will be compacted back to its original dimension after the swelling effect of the steam or soaking solution used to remove the old bushings. This leaves a much firmer base to support the new bushings that will not compress as easily during use.

We manufacture mortise sizing cauls only for keypin sizes .125"- .133" (part #MS-125), .146" (#MS-146)

and .162" (#MS-162). However, mortises for .087" pins can be sized using our regular #4 or DS-162 bushing cauls.

One way to ensure a good bond between cloth and wood is to *glue-size* the mortises before doing the rebushing. This is done by painting the mortise wood with thinned-down hot hide glue, after using the mortise sizing cauls. The effect is much like priming wood before painting - the thin glue mixture penetrates the wood, leaving a surface that is much more receptive to glue adhesion since it is already covered with a thin layer of glue. It also hardens and stabilizes splintered mortise wood. To do this, first obtain some pipe cleaners, preferably the large 1/4" diameter type from a craft store. Pour off some of your hot hide glue and thin it to the consistency of milk. Keep the mixture good and hot, and swab each mortise with a complete coat. This procedure is especially good for helping the cloth shoulders on either side of the front rail mortise stick down. You can proceed to rebush immediately, or let the sizing dry—it doesn't seem to matter.

**5. Select the proper bushing cauls:** After measuring the keypins, choose the corresponding Intermediate and Final bushing cauls according to the chart below:

**Single Shoulder Bushing Caul Sizes (for two caul method)**

For key pin size:	.087"	.125"	.129"	.131"	.133"	.137"	.146"	.152"	.162"
Use Intermediate caul size:	#5	#4	#4	#4	#4	#7	#1	#1	#3
Use Final caul size:	#6	#5	#12	#10	#9	#8	#2	#11	#4

**6. Select proper cloth thickness:** Choose the proper cloth thickness by testing the dry fit of the Final bushing caul. Loop the cloth down into the mortise and insert the final caul (or a keypin). The fit should be snug enough that the key does not fall off when the caul is lifted up, but loose enough that shaking the caul once or twice causes the key to fall off.

Some balance rail mortises are only 5/16" (front to back length) rather than the usual 11/32" - 3/8". In these cases you will need to cut your own strips from bulk bushing cloth to match the mortises. Use an Olfa Rotary Cutter available from fabric stores. And for these instances we can supply bushing cauls cut to match your mortises on a special order basis.

**7. Prepare your hot hide glue:** An ideal hot hide glue pot can be made from an old coffee percolator, or better yet a Rival Hot Pot (from Walmart or similar), prepared as shown here. It is critical to mix the glue in a separate small container, surround it with a water bath, and keep covered with a lid having a hole for dipping. If you have a commercial glue pot it should be used in the same manner. The lid on top contains steam over the glue and prevents skinning over.

The glue should be the consistency of heavy cream; add water or more glue crystals as needed. Sometimes hot hide glue will gel too fast, causing poor adhesion. This is especially true when the shop is cold. To increase the working time of hot hide glue, add urea (a nitrogen fertilizer, available from some garden supply stores and from Pianotek Supply Co. in the proportion of 1/2 tsp. urea per Tbsp. dry glue crystals or more as needed. A thin 3/8" wide stick works much better than a brush to apply the glue.



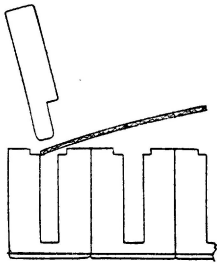
**8. Obtain a sharp knife:** For best efficiency you need a knife that can be comfortably held in the palm of one hand, without having to set it down to pick up bushing cauls with the thumb and fore finger of the same hand. Snap blade knives are ideal and available from any hardware store. With snap-off blade sections a fresh cutting edge is always available without having to stop and sharpen.

**9. Install the new bushings:** With the keys in the key clamps and resting upside down on the bench top, and your glue pot, knife, a small hammer, intermediate cauls and 12" strips of bushing cloth at hand, you are ready to begin. With a piece of bushing cloth held in one hand and extending along the index finger, apply glue to 1 1/2 to 2 inches of cloth (just one inch when trying this the first time). The correct amount of glue is applied by coating the cloth with one stroke of the stick, then wiping the cloth with a second stroke using the dry upper part of the stick. This technique spreads the glue evenly over the cloth while removing excess glue, rather like spreading honey on toast.

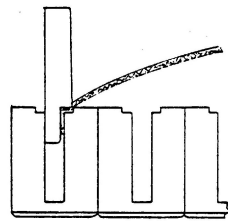
Lay the end of the cloth across the mortise to position it for proper depth (the mortise opening is usually about 3/16 inch wide, which corresponds to the depth of cloth we want), and with the other hand pick up the knife and intermediate caul. Insert the caul, holding some tension on the cloth so more is not drawn into the mortise, transfer one finger from the cloth hand to apply downward pressure on the caul and cut with the knife. Proceed as shown next page until you have used up the glued portion of the cloth (about 5 to 7 keys). At this point, tap each caul lightly with the hammer to make sure they are firmly seated, re-apply glue to more cloth and continue. Work down the keyboard in one direction so the cauls already inserted are not in the path of your work but are behind it. If you are right-handed, you would usually hold the cloth in your left hand, bushing the left side of each mortise as you work from right to left. Note that one hand always holds the cloth while the other always holds the knife, except when applying glue.

If you have 88 intermediate cauls you can proceed in this fashion to the end of the rail. However, it is possible to economize by using only 45 intermediates. After these 45 have been installed, remove the first 25 or so, giving those just installed a little more time for the glue to grab, and continue on with keys 46 to 70, then remove another 18 and complete keys 71 to 88.

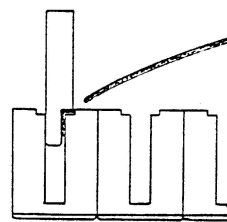
**Bushing the first side using the Intermediate cauls**



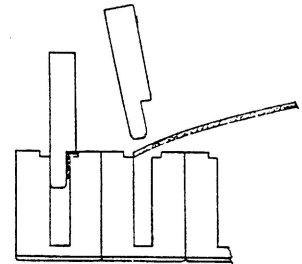
- Apply glue to approx. 1 1/2" of cloth using a flat stick
- One hand holds cloth, the other holds knife and intermediate caul
- Place cloth across key mortise to gauge proper depth



- Insert intermediate caul while holding slight tension on cloth



- Cut cloth while holding caul down firmly
- Keep knife in hand ready to cut the next bushing

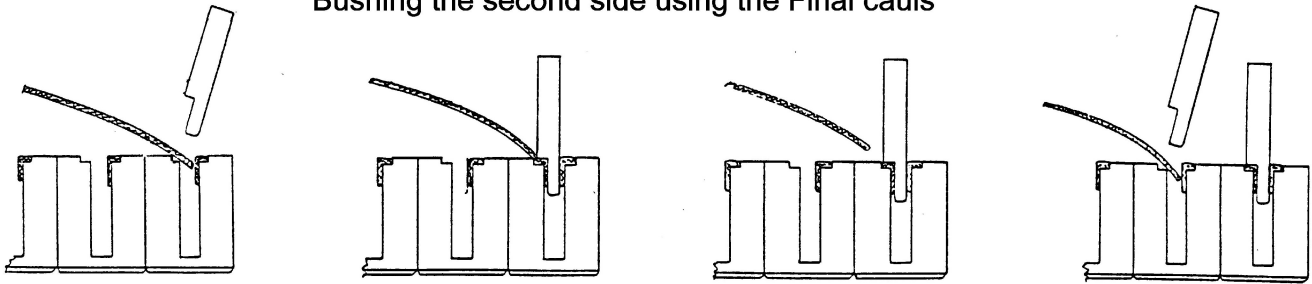


- Proceed for 5-6 keys, tap lightly with small hammer to seat, then apply more glue to cloth
- Continue bushing until whole rail is bushed on one side

Now you are ready to immediately go back and bush the other side of the mortise. Remove all but the last 20 or so intermediates and, using the same procedure, install the final cauls. You can either work back down the rail in the opposite direction or turn the keys/clamp assembly around so you are still working in the same direction as before. (Some prefer to turn the keys around if they are more efficient

working in a particular direction.) The only difference in technique required when inserting the final cauls is to position the cloth so it droops down slightly into the mortise. This gives the same cloth measurement as before in the now narrower mortise and also keeps the glued surface of the cloth away from the bushing already in place. It is wise to check your work in progress periodically to ensure quality. From time to time pull out a caul just after you insert it but before you cut the cloth; look down into the mortise and see that you are consistently getting the cloth down  $\frac{3}{16}$ ". If the depth looks good, re-insert the caul and move on. Also, notice if you are getting any glue squeeze-out along any of the cloth edges; if so, adjust your technique to spread a thinner layer of glue on the cloth. Since the final cauls must be left in place for several hours, you will need 88 finals to rebush one rail at a time or 176 to do both rails at one

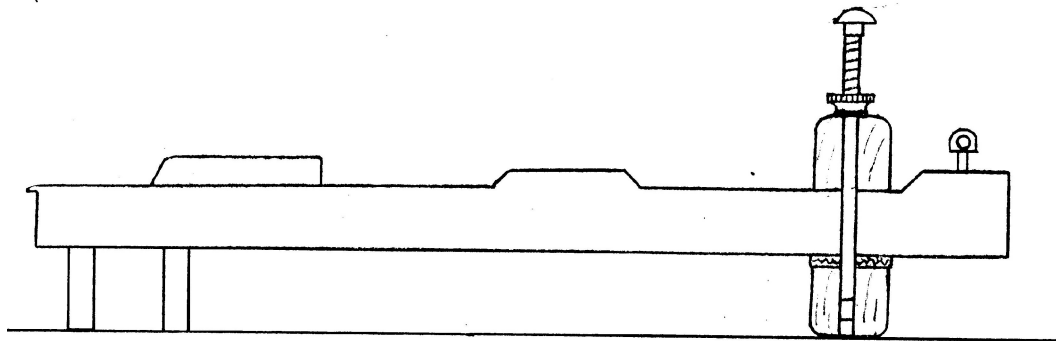
#### Bushing the second side using the Final cauls



sitting.

- Place cloth across and slightly down into mortise to give equal depth on the now-narrower mortise
- Insert final caul while holding slight tension on the cloth
- Cut cloth while holding caul down firmly
- When all front bushings are installed leave final cauls in place for several hours until glue is completely hardened
- Proceed to the balance rail

With the front rail now completed, leaving the final cauls in place, turn the keys & clamp assembly over to expose the balance rail. The



clamp and the final cauls in the front mortises now support the keys in a flat position with the key buttons of sharps and naturals all at one height, making it easy to work on the balance rail.

**10. Bushing the balance rail:** The procedure for insertion of the balance rail bushings is much the same as for the front rail. Note that depending upon which side of the caul is used, the single-shoulder caul design allows you to make either the conventional flush-cut balance rail bushing where the cloth is trimmed flush with the top of the key button, or the shouldered type where the cloth lays over the top of the button like a front rail bushing.

There are two ways of making flush cut balance rail bushings. One is to cut sideways against the flat (non-shoulder) side of the caul. This works but it can be awkward and slow to cut down flush to the key buttons. Alternatively, after inserting the caul with the flat side toward the cloth and while still holding the cloth slightly taut, put a little sideways pressure on the caul with one finger to clamp the cloth in the mortise, angle the knife slightly away from the caul at the bottom and cut downward with a slicing motion, as shown below. Angling the knife makes the cut just to one side of the mortise, leaving a tiny tab of bushing cloth sticking up. Bush the other side of each mortise in the same manner. After the Final cauls have stayed in place for several hours, remove them and trim the bushing cloth tabs flush with the key buttons, either with a razor blade or by clipping them off with a sharp pair of centerpin flush cutters. After all are trimmed flush, any glue residue that might have gotten on the key buttons can be removed with a light sanding.

