

Harpsichord Voicing

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The goal of harpsichord voicing is evenness of tone and touch, at a level consistent with the taste of the customer. Note that tone and touch are intimately related, as the feel of the force required to pluck the string is proportional to the sound produced by the pluck. How is evenness achieved?

- Consistent length of plectra
- Consistent underlap (how far each plectrum extends under its string)
- Consistent width of plectra
- Consistent thickness of plectra

To lay the groundwork for consistent length of plectra, we need to begin with evenly spaced strings, in intimate relationship to the upper guide slots.

A. **Upper guide.** The guide itself is movable, but the slots are fixed. That is to say, the spacing of the slots relative to one another is fixed. While the instrument is played, the guide will be fixed in place, and so the position of each of its slots will be fixed. Taking each slot as a fixed position, we need to ensure that each string is spaced consistently with its slot, so that plectra of equal lengths will underlap their strings consistently.

1. Check spacing. Visual examination is a start (look at the strings and see how evenly they are spaced, how parallel they are, how consistent the nut pins are). But for fine work, “by ear” is necessary. Remove all jacks from the register (numbered and kept in order, perhaps with a jig). Fix the register in place (adjust the capstans on the ends outward, or use shims) in a position so that one jack (which can be an arbitrarily chosen one) will “ghost” (just brush the string) in the “average” slot. Try the jack in a number of slots, and try to find an adjusted, fixed position where it comes closest to ghosting the majority of strings. Now place the jack in each slot in turn and listen. If it misses the string, by how much? If it plucks, by how much? Use slight pressure on the top of the jack while playing, toward or away from the string, to assess accurately.
2. Note that the slots must not be “sloppy” (enlarged too much, allowing excess play). If there is too much play in some or all slots, this must be addressed first, either by replacing the guide, by shimming offending slots, or by shimming jacks (apply narrow strips of gummed paper on either side of the tongue, in the area which bears on the slot during play).

B. **Space strings.** If there are inconsistencies that need to be addressed:

1. Starting at one end of the guide, guide still in fixed position (A1 above), using the same sample jack, place the jack into each slot in turn. If it ghosts, leave that string alone and move to the next.
2. If the string needs to be moved, pull that pin. Plug the hole with a tapered toothpick dipped in glue. Cut flush. Move on to the next slot.

3. When all slots have been checked, all offending pins pulled and plugged (and glue has now had a chance to set), insert the jack into the first slot from which a pin was removed. Using a pin vise with a nut pin as a punch (nut pins are generally a standard centerpin like #19, measure with micrometer to match originals), pull the string along the nut until it is in ghosting position. Play the note while moving the string until you reach the right position. The string should still be at tension. Mark the nut with the pin.
4. Drill a hole of appropriate size (use numbered, 0-60 drill bits, and choose one approximately .003" smaller than the pin). Take a new nut pin, use it to pull the string over to the hole, hammer the pin home.
5. Note that there are physical limits to how precisely one can space strings. How small a distance can you move a pin? How accurately can you drill? Work accordingly. And note that the space between adjacent 8 foot register strings (where there are two 8 foot registers) must be reasonably consistent and above a minimum of about 2 mm (3/32"), to avoid damper interference problems (see G3, below).
6. If you are working on a 4 foot register under an 8 foot, or an 8 foot over a 4 foot, observe the stagger of the spacing from one to the other. In general, you want the 4 foot strings spaced as far from the 8 foot as possible, while still allowing room for on and off movement of the jacks, and for adequate length of 4 foot plectra. See I(5), below, concerning the effect on 4 foot dampers.

C. Prepare jacks

1. If there are tongue adjustment screws (top of jack), adjust all consistently, generally so that the back of the tongue is even with the back of the jack.
2. Check for adequate tongue spring strength: all tongues should snap back instantly to full forward position. Check by holding the jack horizontal, plectrum side up (spring down), to see that the spring is strong enough to overcome gravity (a little extra cushion). If some are sluggish, check for possible friction points. The spring should be just strong enough to move the tongue positively and rapidly to the forward position, acting against minimum friction. Too much strength will cause repetition problems.
3. Some jacks with tongues that snap into holes in the jack body develop friction at this point over time. I have found that this is usually due to damper felt that is too thick, pressing outward on its slot and causing an inward pressure on the portion of the jack that holds the tongue. Damper felt should be thick enough to be held positively in the slot, not so thick the it must be forced in.
4. To strengthen a plastic spring, generally give it a bend in its middle. Avoid stressing the point where the spring leaves the tongue body. For jacks with top adjustment screws, back the screw off enough to free the tongue so that it can hinge forward, bend the spring, replace. For Zuckermann style jacks, it is necessary to remove the tongue to adjust the spring. Bristle will need to be replaced (China bristle paint brushes are a convenient source for bristle).

D. Install plectra

1. Immobilize the upper guide so that the slots are a chosen distance from the strings, meaning a distance equal to the chosen plectrum length. Typical 8' plectra range from 3.5 – 5.5 mm. For 4', 2.5 – 3.5 mm. This is a matter of

taste. In general, shorter means more nasal sound, crisper feel, less key dip used during pluck; longer means more mellow sound, more pliant touch, more key dip used. Keep in mind the physical limitations: plectra cannot be so long that, in the off position, the back of the jack comes into contact with the neighboring string. And short plectra are more difficult to voice.

2. Remove existing plectra. If the slot in the tongue has a “cross,” this will be an easy matter: cut the plectrum flush with the front of the tongue (use flush cutting pliers, like for centerpins), and, supporting the back of the tongue, push out with a jeweler’s screwdriver held at right angles to the remnants of the plectrum. If the slot is “simple,” it can be troublesome. First try grasping the plectrum with right angle pliers just ahead of the tongue (about 1 mm), and, supporting the tongue, press it backward. If this technique won’t budge a strongly wedged plectrum, try cutting the plectrum about 1 mm forward of the tongue, and press on this stub using a blunt object (thumbnail, screwdriver handle). If this doesn’t work, either, cut the plectrum flush with the tongue and press out with the blade of a fine screwdriver (hard to do). In all cases, supporting the back of the tongue is essential, to avoid damage to the spring.
3. Install a new plectrum in the tongue slot. Material varies in thickness. 0.020 - 0.021” works most often (0.0185 and 0.016 are also seen, occasionally other sizes). If there is curvature to the plectrum, install so that it curves upward. See that the new plectrum extends far enough through the tongue. If not, replace with a narrower one (or narrow that plectrum a bit). If the back of the plectrum is so long that it will interfere with the neighboring string, cut it with flushcutters, leaving a bit of stub (perhaps 2 mm).
4. Cut plectra to length individually so that each ghosts (guide is immobilized in position). The cut should be an acute angle, 30 – 45° (so plectrum will return under the string and not hang up). A good technique is to cut a little long at the acute angle (by perhaps 0.5 mm), then cut the very end with a perpendicular cut. This allows for tiny changes in length, and removes any burr that might impede repetition (hang on the string). Very small adjustments of the top adjustment screw may be used to “fine tune” the ghosting. If you cut too much, the stub on the back of the tongue can be pushed with a thumbnail to force the plectrum forward a bit. After a few plectra have been successfully cut to ghosting length, a groove will have been made on the voicing block, which can be used as a guide. When done ghosting, you may trim the back of the plectrum flush. I prefer to leave a small stub, to grab for easier plectrum removal, and possibly to shove the plectrum forward a bit in case of over-voicing in the future.

E. Adjust register stops

1. On position should be adjusted so that the ends of the plectra underlap the strings by about the width of the string or less.
2. Off position should be adjusted so that all plectra miss their strings all the time, with a minimal safety factor.
3. Note that on and off positions are very important for dampers. The damper felt needs to extend far enough beyond the end of the plectrum so that it is still on

the string in off position. But in the on position, it mustn't damp the neighboring string. Hence, on/off movement should be minimized.

F. Set plucking point

1. "Plucking point" is how far the jack (hence the key) must travel before the plectrum contacts the string, somewhat similar to "lost motion" in upright piano regulation. It is adjusted by lengthening or shortening the bottom of the jack. This is fairly easily accomplished by turning the screw when an adjustment screw is present. Otherwise, material must be removed or added.
2. Each register will have a different plucking point. In general, the order of pluck is 4 foot, back 8 foot, front 8foot (upper keyboard) for a double manual instrument; front 8 foot, back 8 foot for a single manual; or 4 foot, foot' for a single manual with that configuration.
3. The first to pluck will be closest to the string in rest position. It cannot be so close that the plectrum will "fail to return" when the key is released slowly, or so that it will jangle against the string while at rest. There must be enough room for the jack to hang on the string by its damper, with the plectrum hanging beneath and out of contact with the string, with a small safety factor to allow for humidity change (Dryness will shrink the nut bridge, lower the string level, and cause plucking point distance to shrink. Wetness will increase plucking point distance).
4. Successively plucking jacks will have plectra that are successively farther from the string. The last to pluck must still be able to complete pluck within the range of keydip (with jackrail attached).
5. Having established a good guess at the right distance for the register you are working on, adjust all jacks so that they are consistent. Feel this consistency dynamically by lightly pressing each key until the plectrum contacts the string, like feeling for consistent aftertouch. Check it as a static distance by lightly resting fingers on a number of adjacent keys so that plectra contact their strings, and check for key level to be consistent. (NB key level at rest must be accurate for this method to work well).
6. Lacking adjustment screws, material may be removed from the bottom of the jack using a file or sandpaper. I like to hold a piece of sandpaper on the bench (perhaps taped down if doing a lot of jacks) and rub the bottom of the jack against it. Large amounts may be sawed off with an Exacto saw, fine toothed bandsaw, or the like. Adding material is difficult, so be conservative in cutting.
7. To add material to the I-shaped Zuckermann jack, use gummed paper (address label or equivalent), and stretch it around the narrow bottom of the jack, attaching at both sides. For other designs, with more surface area, carefully matched shapes and sizes of card stock may be glued on (Barge cement, PVC-E, or use gummed paper). You want to apply the card stock so that it doesn't protrude, or it may be knocked off when the jack is removed.

G. Adjust width of plectra

1. Raw plectra usually vary considerably in width. Establishing consistent widths is a good first step to even voicing. Generally one wants to taper from wider in the bass to narrower in the treble. Width tastes vary. My preference is for

about 1.5 mm in the bass tapering to about 1.0 mm in the treble, with parallel sides starting as close to the tongue as it is possible to start trimming. Some prefer a profile that tapers to a point, or a near point. If replacing single plectra, reproduce the existing pattern, if any. To trim, use a subtle slicing motion, beginning with the tip of the scalpel very close to the tongue.

H. Adjust thickness of plectra

1. Now we start to listen carefully, but also to feel carefully. The amount of force required to complete the pluck will correspond, in general, to the sound level, particularly with plectra of even lengths, which is why we have gone to such trouble in string spacing and ghosting. A good approach: do all C's first, matching octaves and double and triple octaves. Play separately and together and listen for balance. Then do an intermediate note (F, F#, or G) in all octaves. Then fill in the gaps.
2. Technique: first shave the corners, then the bottom. A subtle slicing motion, with the bevel of the blade carefully angled in line with the cut, will allow for smooth, even removal of material. Any chatter of the blade should be avoided. Chatter is caused by a dull blade (replace or sharpen), by too steep an angle (blade to material), or by failure to have a bit of a slicing action (just pushing the blade into the material).
3. The thickness of each plectrum should be consistent from tongue to tip, either the same thickness throughout or tapered. There should be no "hills and valleys," no thin spots. This will affect how the plectrum bends, and how likely it is to break. Use good lighting and magnification to check your work.
4. For a more mellow sound and a more pliant feel, taper fairly aggressively toward the tip. The image to have in mind is the plectrum bending in a parabolic curve, and thereby pushing the string to the side as opposed to lifting it. A plectrum that is closer to the same thickness all along its length will lift the string more before bending enough to allow it to slide to the side. This gives a more nasal, percussive sound to the voicing. Balancing between those two extremes allows one to create a desired timbre and feel at the same overall "loudness."
5. Gram weights may be used to check the ear and touch. But be very careful and consistent in their use. There are two basic techniques, static and dynamic.
6. For static, support the key from underneath (or pressing against the front with a finger), resting the weight on the key, and gently lower the key until the plectrum is in contact with the string. Then quickly release the key. 100 grams is a good ballpark weight that should complete the pluck under this method.
7. For dynamic measurement, hold the weight on top of the key at rest position. Release the weight suddenly. By this method, 70 grams is a reasonable rule of thumb weight. But note that this method will give inconsistent results unless the plucking point has been set consistently. The momentum achieved during the freefall of "lost motion" before the plectrum reaches the string allows for the lower weight, and this is closer to what the performer feels. It is a good idea to use both methods to check for evenness, as well as feel and ear.

I. Install damper felt

1. The best material, in my opinion, is high quality key-bushing cloth, cut, not torn. We want a smooth edge to the felt, so that it will slide readily on the string when the register is turned on and off.
2. Using a strip of appropriate width (approximately 4 mm), slide it into the groove with both hands, one on either side of the jack. Pull it down until it is just above the level of the plectrum. Then adjust the forward edge so that it protrudes just beyond the tip of the plectrum. Cut the back flush.
3. Install the jack and check. Does it damp? Adjust the felt downward if not. Does it protrude far enough to stay on the string in off position? Pull forward if not. Does it protrude too far and partially damp the neighboring string in on position? (Play or pluck that string to check). If so, trim with sharp scissors, the ones you use to trim trichord grand dampers.
4. A good tool for adjusting the damper felt up and down, in and out, is a pair of right angled pliers. Grab the felt just in front of the tongue. It will maintain the felt at right angles to the jack more easily than using fingers.
5. For four foot jacks, there is a problem of interference with the eight foot register string above. Hence, the felt must be very carefully tapered and cut to length. The felt strip should be narrower than for eight foot, perhaps 2.5 mm, and should be cut with scissors to an acute angle (flat side will be down) before inserting in the slot. Extra care must be taken to ensure that the length of the felt is the minimum possible in most cases, as the stagger of the string spacing between 4 foot and 8 foot registers may be very close. Minimum movement of the 4 foot register between on and off is helpful in trying to keep the felt on the string in off position. Also helpful is minimal underlap of 4 foot plectra.

J. Adjust stagger

1. Multiple registers should pluck in succession. If they pluck simultaneously, or too close together, the touch will be too heavy. If they pluck too far apart, there will be too much key dip needed, and a choppy feeling touch.
2. In general, one aims for the first jack to complete its pluck at the same time the second jack's plectrum is contacting its string. In practice, with two 8 foot registers and a 4 foot, one may need to compromise. But in any case, it must be possible to play the key in a slow, controlled manner, and hear and feel each pluck occur separately and evenly.
3. Setting stagger is trial and error to a large extent. All plucks must fit within the chosen keydip (which may possibly be varied by adjusting jackrail height or felt thickness, or by trimming the tops of jacks). More dip will be required to achieve pluck in the bass, so it is wise to begin there to find what problems may arise.
4. Adjusting stagger is a refinement of "setting plucking point" (F, above). Plucking point standards should be kept in mind while adjusting stagger.
5. It is desirable for the upper manual to have a close plucking point when played alone, but the upper manual's jacks are generally the last to pluck in a staggering sequence. This is achieved, in fine work, by making sure there is a

slight degree of lost motion between the coupler dogs of the lower keys and the bottoms of the upper keys.

K. Finishing up

1. There is a circularity of procedure here. Adjusting plucking point and stagger may affect damping, which will have to be re-adjusted. It may be that slightly more or less underlap or more or less stiff plectra, will be required to achieve a good finished product. So the approach should be interactive, with circles of refinement of all steps.