Key Bedding Protocol for Grand Pianos

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4/1/2016

Chris got injured and could not tune. He found himself in the shop all the time without an assistant. He found himself with a lot of time being surrounded with things that annoyed him. It takes a lot to learn to tune, even with an ETD. It takes a lot to learn to be a successful business operator. We come to a place where we just have to get on with things. We attend a class where people just tell us what to do. It's hard to get to the other side of the river with all the information needed, and to get to a place where it's joyful and easy.

For Chris, it all happened with an idea. Take a key bed and extend it. Think of the plane of the key bed to be above the keys. Think of things in a vertical relationship. We are maintaining our overall verticality with gravity. When hammers strike the string, they are vertical. When we have good posture, we are vertical. When piano hammers are well filed and fit the strings, we can achieve our end target of stability. We want a solid rigidity so our input of energy is strong and does not give.

From this line of thought, Chris developed a series of tools that he integrated into grand regulation over an eight-year period. WNG makes a key frame bedding tool that touches on the pin block and sits on the button. The first thing to do is to back all the screws up, and you can see with the gauge where it is. Take the spring out, because with it in the action is pushed up off the key bed, giving a false fitting and reading. Now the glide bolts can be set at an accurate setting. Replace the spring and check. If the action lifts, remove the spring again and shim.

Always keep the screws in order. A small screw in a big hole can create problems. The spring could be grooved. Take a sanding block and address this issue. Some piano dags have a machine screw for setting the back stop of the action. Cut a front rail punching so it fits over the screw in the dag. Asian key frames have more flexibility than the Steinway-Mason frames that are stiffer. Note if there are any hidden stubs. There is a range of motion; when you press on the pedals, things change in the key bed. A flexible key frame would go down to its lowest setting.

A good bedding job is basic. You have a flat bed and a flat set of rails. However, if there is a glue drop or some over-spray, fitting will not work: clean it off. Another thing might be alterations in structure, for example if one side is higher than another: plane it off.

The front rail is held by cheek blocks. The back rail is held by studs. If the keys bounce because the back rail is cantilevered and sprung against the front, a player will have difficulty. With the knocking system, you can hear. If you have sight, you can see the indicator on the tool; however, the top of the tool can be removed so that the setting is touchable. If you don't check them all, one of them could be high and you're getting a false reading. The least sensitive place is the place with the most weight.

If you press really hard, you get a false read. Moderate pressure will give contact. It's the same as tuning: go a little past and then go where it should be. Validate each process. If you go a little too far with any step, it influences all the steps around it.

Think about whippen return springs. Springs are wild cards. Where do we adjust them and what do we adjust them to? A heavy weigh-off could make the return even. Well-done, these springs remove inertia.

There is a big advantage to working on the key fame with no top stack, no keys, no cheek blocks, and no spring. While pressing on the action cleat with one hand, tap along the back rail to find the noisy areas. If it didn't tap before, did the weight of the top stack complete the fit? A balance punching under the rear foot of the action bracket top stack might save two hours of sanding.

If you decide to sand, mark with chalk where the parts are that are touching. Using a sanding block with 220 on one side and 120 on the other, take off as little wood as possible from the underside of the back of the key frame. Now set the top stack on the key frame with no screws. Tap along the balance rail. With a Renner voicing chopstick tool to reach down through the strings to the foot of the action bracket, tap again on the hole of the foot of the top stack: tap right where the hole goes into the frame. Ideally there would be no tap with no action. If there is no tap with no keys, that's good because the keys will add weight to it. If it fits close enough now, then we have saved two or three hours to make one spot fit.

Take a couple sheets of 220. Use 120 maybe, but be careful. Lift the front of the key frame, insert the sheet of sandpaper facing upward to the bottom of the key frame, let go of the frame so it rests freely, and pull out the sandpaper. Sand as little as possible. We are first after a general fit. Employ the policy of the least work possible to complete the job because there is so much other work to do as well.

Steinway cheek blocks wear and need adjustment. Using a hammer square, the back side of the spring can be shimmed. Sometimes the spring can be bent with an upright spring bending tool. Front rail punchings can be placed behind the spring and then tighten the screws. On cheek blocks, sometimes the adjustments need to be shimmed. No matter how much muscle is applied with other adjustments, the cheek block setting shouldn't move. If something doesn't fit, it can be made to fit.

Using a string hook, go from bass to treble and adjust the height of all the strings by pulling up. If they are moderate, they will come up. If the strings are under-lifted, the agraffe and V-bar create a spring that makes the string unstable. Adjust the strings to the hammers. Under-lifted strings are a problem. If your agraffe is level and the bridge is angled, the string is moving in a twist. Strike is under the bar and under the dampers; fit the strings to the hammer. This must be done at pitch and in tune.

If the string does not come in contact with both the bridge pin and the bridge, there will be a problem. Seat the strings. The tail of the string after the bridge is not for a duplex scale but to reduce the tone.

Filing the hammer to fit the string will create a harder hammer on one side than the other. Poking and additives don't really address tone issues. Invent tools to set up adjustments so the problems don't occur. If a plate is curved, lift the treble string more than the center string more than the bass string so that the string is parallel to the hammers. A good tone at high volume creates a good tone at soft volume. All the hammers should be vertical, not tilted.

The back shoulder of the hammer has an arc that goes around the center. The front has a shorter arc. The hammer is flared. If you tilt the hammer for clearance, the greater effectiveness of the weight will be on the bass side of the hammer. When it is in motion, the bass side is moving faster, which also makes it heavier. When the hammer is tilted, there is a problem because the weight is off balance. A slight tilt the other way might help, but it has other problems. The ideal is to have tha hammer vertical all the way. The fatter the hammer and the more flare, the less clearance there is. Take some felt off the sides, which helps both the

clearance and the tone. Make sure the pinning is adequate enough to give the hammer freedom to move, but snug enough to hold it firmly. Travel the hammers so they move vertically and are not tilted.

We want to know that the strings are level, that the hammers and strings fit, and that the hammers are vertical before we do any voicing or needling. Chris does 2/3 of his work from behind the action.

Set leveling samples. To level the keys, Chris made a jug with a hole in it and an adjustment machine screw that is snug in the Teflon block. Remove the bedding samples first, then the strike samples second. There are more strike samples than bedding samples, and one is longer than the other so they can be told apart. Set up the keys to be the right height with the jig under each of the two end keys. To prevent the possibility of a concave or a convex workbench, place a third jig under the center key. Use a straight edge with a slight curve: 1/32" higher in the center than the ends. We are not looking for perfection, but adjustability. Punchings are thin enough to make a difference in the dip of 3/1000". Now we are ready to work on the bench.

Choose where your bedding samples will be. Bedding is based on cheek blocks, fall board, key stop and key level. Gather bedding and leveling punchings together. Each stud will need two things: Remove punchings at the studs. We also will need strut samples. Bedding sample is a key step that lifts the key up to the key at rest, memorizing through the key where the key frame is. For the string height to be accurate, we need the key frame sitting on the bench accurately.

How do we know on the bench what is the same hammer rise for a given dip? What is the difference between the bed and the bench? One way to know is to know that we can't back up the pin any more. The other way is to make the sample match what it is in the piano. The balance rail sits on the studs. On our irregular benches we need to use the glides to set the height. If you change the studs at the bench set-up, you have to reset them in the piano. Touching the studs takes only a few minutes and they don't have to be removed.

Glides. Take up the weight of all the keys until the keys barely tap. Then lower them until the keys don't tap. When we touch up the regulation, we won't have to do this. The gliders adjust the key height. A good form of shimming is the front and back rail punchings. So they can be removed, the punchings go half-way under the edge of the rail at the marks made earlier.

Install Key Steps. Remove punchings at each of the studs and insert the screw-adjustment jigs on those front rail pins. Tap the front of each of these keys and adjust each screw until there is no movement. The two end keys and the center key are pre-set to be level. The rest simply match the location of the keys as they are, whether they are level or not.

As a precaution, size the top stack bracket screw holes with yellow glue. Installing the key steps accomplishes three things: (1) sets markers for the key level, (2) Rough in the front rail to the bench, (3) tell us where the key frame is. Set up a let-off rack with hey height samples and let-off samples. A hard dip and a hammer rise, must be done by view or with a gauge. A let-off rack enables measuring samples on the bench. Fully regulate one or two sample notes to make sure it all works.

Set strike samples. Measure with the hammer what is the distance the hammer travels to kiss the string. Normally this distance is 1-3/4". With a WNG key weight on a white keywith no front-rail punchings, back off the let-off button until it blocks. Now lower the let-off button until the jack escapes. You will see the key drop at let-off.

Grandwork Bedding Protocol

A Solid Foundation for Grand Regulating

Initial Preparation:

1. Remove action and return spring – dress the spring side of key frame if grooved.
2. Clean and dress key bed as needed – retain original surface levels if possible.
3. Tighten hammer flange screws and correct changes to hammer spacing.
4. Rough hammer shanks off rest cushions and solve any excessive friction.
5. Return action and regulate cheek blocks:
    a. Polish or deburr key frame guide pins as needed.
    b. Remove cheek block shims and/or shim bracket for bearing.
    c. Add front rail punchings under cheek blocks to complete fit – leave unglued.
    d. Cheek blocks must not apply more pressure than needed, however firmly tightened.
6. Secure cheek blocks and bed balance rail, pedals depressed, using WNG bedding tool.
7. Check back rail (tap long screwdriver resting on back rail cloth) and front rail (tap with finger).
8. If solid, install return spring (square as needed) and proceed to step 38.
9. If not solid, remove top stack and keys from key frame.
10. Clean key frame and clean, restore, or replace materials as needed.
11. Polish or replace key pins, capstans, and glider studs as needed.
12. Tighten key frame screws and glue reinforce top stack screw holes.
13. Back glider studs up out of the way.

Bed Back Rail:

14. Bed back rail (no keys, no top stack, no return spring):
    a. Shim dags to stop key frame at cheek block positioning.
    b. Tap on back rail cloth.
15. Identify areas that tap back, and note with chalk on back rail cloth.
16. Touch down either side of no-tap areas – do not sand a gap that is too big to tap!
17. Remove key frame to rest front of front rail on floor (protect floor as needed).
18. Sand key frame, using 220 or 120 open coat sandpaper on sanding blocks.
19. Take away least material possible to eliminate tapping from no-contact areas.
20. Clear dust away from key bed and key frame as you go.
21. If light touch between sections eliminates tapping, top stack can complete fit.

Fit Top Stack to Key Frame:

22. Remove key frame, installing top stack with no screws, and return it to piano.
23. Tap feet of action frame and shim to just eliminate tapping.
24. Back feet require reaching through strings with long screwdriver.
25. Balance punchings work well as shims. Glue to cleats and trim when done.
26. Screw on top stack (still no keys) and validate back rail bedding.

Bed Front Rail:

27. Confirm no balance rail contact.
28. Remove least material from front rail contact spots to achieve full contact.

29. For a crowned front rail, fit the middle and leave spaces at ends equal if possible:
    a. One at a time, hold down ends of front rail and tap test fit toward the middle.
    b. Draw 220 sandpaper strips between key frame and key bed, grit-side up.
    c. Sand small amounts, blow out dust, and test.
    d. Taper sanded into un-sanded areas.
30. Touch up cheek block fit by changing front rail punching shim sizes.

Bed Balance Rail:

31. With the top stack on and still no keys, secure cheek blocks.
32. Turn glider studs down to bear on, but not tear, strips of newspaper as they are pulled out:
    a. Do not change hidden studs: when present, they set range for balance rail.
    b. But shim them with strips of newspaper before setting rest of studs.
    c. The balance rail will be tweaked when action is assembled.
33. Remove newspaper shims and tap-validate all three rails.
34. Remove cheek blocks and key frame.

Fully Assemble Action and Use WNG Bedding Tool:

35. Assemble action, install (still no return spring), and secure cheek blocks.
36. Touch up balance rail bedding with WNG Bedding Tool (BT).
    a. Firmly depress sostenuto and sustain pedals.
    b. Place BT beside each glider stud and push down on stud.
    c. Outer studs (including hidden studs) should not change BT reading.
    d. For studs that do change, turn down until they don't.
37. Validate that front rail and back rail have not changed, and remove cheek blocks
38. If crowned fit, find fulcrum (last point of contact) in bass and treble; mark them on rail.
39. Using feeler gauges, measure flush to ends, noting size that taps and size smaller that doesn't.

Install Return Spring, Take Samples, and Proceed to Bench Set-Up:

40. Install return spring and square (to Hammer Square) using front rail punchings as shims.
41. Employ the Grand-work Key-step Protocol with a Bedding and Strike Kit for in-piano sampling.
42. Follow the Grand-work Regulation Protocol as a checklist for on-bench regulation.