

The Grandwork™ Regulation Station Deluxe

Setup and Order of Operations

A At Piano: First Steps and Short-Form Keyframe Bedding

- 1 Remove and store music desk (clean up dust and debris as they are uncovered).
- 2 Check action fit in case parts, keys to fallboard and keyslip, keyframe to cheekblocks.
- 3 Moderately lift all strings near agraffe/capo to stabilize underlifted strings (stable strings won't change).
- 4 Remove and store fallboard and keyslip.
- 5 Remove action to a work surface and tighten screws.
- 6 Remove and store shipping rail, nuts, and screws (keep in order).
- 7 Select which naturals will be used for sampling and extract their frontrail punchings:
 - a. One bedding sample beside each glider stud (most stable and most sensitive to changes).
 - b. End bedding samples double as leveling samples – no need for sharp samples yet.
 - c. One sample mid-range for frontrail validation and/or replication of crowned fit.
 - d. One strike sample near each end of each section (but not bedding samples).
 - e. And one additional strike sample, shared by two butting templates for a long tenor section.
- 8 Store sample punchings in order on machine screws and set aside.
- 9 Make sure shanks are off rest cushions and no samples have excess friction.
- 10 **Remove return spring** – painter's tape screws to spring and draw orientation arrow:
 - a. Return springs embed themselves in keyframes over time, obstructing balancerail adjustment.
 - b. Even with no indentation, the pressure applied adds friction that obstructs adjustment.
- 11 Clean keybed and solve any keybed surface irregularities that would prevent stable bedding.
- 12 Install action and regulate cheek blocks (in particular, they must not over-press guide pins):
 - a. For crowned frontrail, secure cheekblocks and check for too loose by tapping at each end.
 - b. If no tap, add a white frontrail punching under the front of each cheekblock.
 - c. If still no tap, find punching size that produces a tap and back up one size for just no tap.
 - d. For full fit, add a punching six inches from each end to create a gap for this test.
- 13 Check frontrail and backrail bedding:
 - a. Back up glider studs out of the way.
 - b. With cheekblocks secured, tap test frontrail with finger.
 - c. Tap test backrail with long screwdriver through strings onto backrail cloth.
 - d. Test at the back of backrail cloth (front of backrail might tap back when lip actually fits).
 - e. If both fit, bed balancerail with **WNG Keyframe Bedding Tool** (see [Grandwork Bedding Protocol](#)).
 - f. Finish balancerail with pedals fully depressed and proceed to step **C1** to start sampling.

B At Piano: Long-Form Keyframe Bedding (if validation fails in step **A13**)

- 1 Bed backrail (remove topstack and keys, store topstack screws in order):
 - a. Shim dogs to stop keyframe at cheekblock positioning.
 - b. Install keyframe and tap backrail cloth over lip that contacts keybed.
 - c. Identify areas that tap back with chalk on backrail cloth.
 - d. Press down on either side of no-tap areas to validate – **do not sand a gap too big to tap!!**
 - e. Remove keyframe to rest front of frontrail on floor (protect floor as needed).
 - f. Sand designated sections of backrail, using 220 or 120 sandpaper on a flat sanding block.
 - g. Take away least material possible to eliminate tapping from no-contact areas.
 - h. Clear dust away from keybed and keyframe as you go (wear a dust mask).
 - i. If a light pressure between sections eliminates tap, shim topstack to complete fit.
- 2 Fit topstack to keyframe:
 - a. Remove keyframe, install topstack with no screws, and return keyframe and topstack to piano.
 - b. Tap feet of topstack and shim to just eliminate those that tap back.
 - c. For tap-testing back feet, reach through strings with a long screwdriver.
 - d. Balance punchings work well as shims – glue to cleats and trim when done.
 - e. Screw on topstack (still no keys) and validate backrail bedding.
- 3 Bed frontrail (confirm no balancerail contact except for hidden studs, if present):
 - a. Remove least material from contact spots to achieve full contact.
 - b. For a crowned frontrail, fully fit the middle, leaving spaces at the ends (equal if possible).
 - c. One at a time, hold down ends of frontrail and tap-test fit toward the middle.
 - d. Draw 220 sandpaper strips between keyframe and keybed, grit side up.
 - e. Sand small amounts, remove all dust, and test.
 - f. Taper sanded areas to unsanded areas for a general fit (not changed with soft-pedaling).
 - h. Touch up cheekblock fit by adjustment feature or by changing shimming.
- 4 Bed balancerail (with fully assembled action installed and with cheekblocks secured):
 - a. Use **WNG Keyframe Bedding Tool** to touch up glider studs with pedals depressed.
 - b. Validate backrail and frontrail fit and proceed to sampling.

C At Piano: Samples for Key Level, Keyframe Bedding, and Hammer Strike

- 1 Pre-level first and last naturals as leveling samples:
 - a. Cut a slot in and tweezer-install balance punchings to achieve desired key height.
 - b. If not leveling keys, shim end naturals up slightly higher than all other naturals.
 - c. Later, added punchings will be replaced with uncut punchings or removed.

- 2 Secure cheekblocks and add **Keysteps** to bedding sample frontrail pins (not strike samples):
 - a. Use either 12mm or 10mm **Keysteps**, depending on space between key and frontrail.
 - b. Center **Keysteps** under keys and push them against keypins for accuracy.
 - c. Turn up each bedding sample **Keystep** to just touch its key.
 - d. Use tap/no tap testing to validate.
- 3 Place crowned side of **WNG Key Level Stick** on supported leveling samples flush to front of keytops:
 - a. Turn up midrange sample **Keystep**, lifting its key to just touch the **Key Level Stick**.
 - b. Tap-test all three points of contact for equal no-tap and stability.
 - c. For crowned fit, make sure cheekblocks are secured.
- 4 Set kissing samples of strike with **WNG Key Dip Tool** (without crossbar) placed on front of sample keys:
 - a. **If hammers have wearmarks, shift action so wearmarks are between strings:**
 - i. Strings cut “valleys” in a hammer’s crown, but a template can only touch the “hills”.
 - ii. Use wedge shim between cheekblock and keyframe if return spring is in.
 - b. Back all strike sample letoff buttons so hammers block against their strings.
 - c. With **Key Dip Tool** on keys, adjust buttons so hammers “letoff” with a slight hesitation.
 - d. This will accurately indicate strike height on the bench once the bedding has been replicated.

D At Bench: Set Up Custom Keybed

- 1 Install the **Custom Keybed** on bench or base and shim or reposition for stability.
- 2 Leave *balance beddingrail* centered (except for concert grands).
- 3 Loosen *slipper tracks, back and front beddingrails*, and all *bedding elements*.
- 4 Spread *slipper tracks* and outer *beddingrails* to positions beyond size of keyframe.
- 5 Add fully assembled action to **Custom Keybed** and turn *back and front beddingrail stops* to “up” position.
- 6 Pull *treble and bass slipper tracks* (fully extended at back) in sideways to hug keyframe to the center.
- 7 And center keyframe’s balancerail over the *balance beddingrail*:
 - a. All glider studs (including one that is offset) must bear on *bedding platforms*.
 - b. Pull in *back beddingrail* so *stops* touch keyframe’s backrail and tighten *slipper track* connections.
 - c. Push in *front beddingrail* so *stops* touch frontrail and tighten outer *beddingrail* connections.
 - d. Confirm that *slipper tracks* and *beddingrail stops* all still touch keyframe.
- 8 Lift action’s frontrail and pull slightly forward onto tops of stops to see under *balance beddingrail*:
 - a. Reach in with 12” Phillips screwdriver and push *bedding platforms* sideways into place.
 - b. *Bedding platform wedges* should be under contact points of glider studs.
 - c. Also place *bedding platforms* under hidden studs, if present.
 - d. Position extras clear of working *bedding platforms*.

- 9 Evenly disperse *front and back beddingrail bedding elements*:
 - a. For stability, center middle *bedding elements* over the middle **Custom Keybed** rib.
 - b. Make sure outermost elements on *front beddingrail* are *bedding platforms*.
- 10 Remove action, tighten all screws, and secure *bedding support* near center of *back beddingrail*.
- 11 Rest flat **Level Stick** on *slipper track* flanges and adjust end frontrail *bedding platforms* to just kiss it:
 - a. Also, rough in *back, balance, and front bedding elements* to flat side of **Key Level Stick**.
 - b. For a crowned frontrail, rough in *front bedding elements* to **Key Level Stick's** crowned side.
 - a. **Key Level Stick** won't span slipper flanges over *back beddingrail*: go back/forth to level *elements*.

E At Bench: Set Keyframe Bedding on Custom Keybed to Keysteps

- 1 Place action on *slipper tracks* touching *back beddingrail stops*:
 - a. Turn down *front beddingrail stops* now to be out of the way.
- 2 Turn up any backrail *bedding elements* that don't touch, so all firmly touch keyframe:
 - a. Turn *bedding platform* screws counterclockwise to raise elevators, clockwise to lower.
 - b. Or tip one side of *bedding block* up, leaving other side on rail, and secure.
 - c. In new systems, *bedding platforms* replace *bedding blocks* (**upgrades available**).
 - d. Tap-test validate keyframe's backrail over both *slipper tracks* and *bedding elements*.
- 3 With a full-fit frontrail, touch inner *bedding elements* to keyframe's frontrail and tap-test validate.
- 4 With a crowned fit, adjust *balance bedding platforms* so end keys just kiss their **Keysteps**:
 - a. Apply *holddowns* to guide pins, just enough to connect keyframe to outer *bedding platforms*.
 - b. Place the crowned **WNG Key Level Stick** on leveling samples.
 - c. Adjust middle *front bedding element* until midrange sample just kisses **Key Level Stick**.
 - d. Adjust bass and treble inner *bedding elements* to touch frontrail firmly without changing middle.
- 5 Finish bedding by adjusting balance *bedding platforms* under action with 12" Phillips screwdriver:
 - a. Make two passes to overcome seesaw effect (**do not adjust glider studs or Keysteps**).
 - b. Adjust *bedding platforms* until keys tap on their **Keysteps** when lightly tapped.
 - c. Once all tap, then eliminate tapping for each and validate that none tap.

F At Bench: Set Up Regulating Rack

- 1 Aim **Regulating Rack feet** toward back – this direction frees more space for side blocking.
 - a. *Templates* install on back side of *template rail*.
 - b. This way, LEDs will light both *templates* and hammers.
- 2 Loosen **Regulating Rack brackets** and *slippers* and align *templates* over hammer crowns.
- 3 Position legs so *feet* just touch inside of slipper track channels and secure both *brackets* and *slippers*.
- 4 Choose *templates* from **Template Set** that slightly more than span sections of hammers.

- 5 Spin off *template thumbnuts* from their studs, install *templates*, and spin *thumbnuts* back on.
- 6 Line up *templates* with sections, leaving spaces between, except in a long two-*template* tenor section:
 - a. Find tenor section high point in piano – often note 37 in bigger grands, note 40 in smaller.
 - b. Select and butt two *templates* over that note – together the two slightly over-span section.
- 7 Set lower **Regulating Rack** *stop collars* at equal heights above their *feet* (try 1.75” using **Gauge Key**):
 - a. *Template rail* dropped all the way down will hold *templates* at hammerline.
 - b. Rough in *template* heights so their lower edges are just above as-is hammers at rest.
- 8 Now raise **Regulating Rack** *brackets* blow distance above lower *stop collars* (use **Gauge Key**) and secure.
- 9 Adjust *upper stop collars* to touch top of *brackets*: all the way up will now be strike position.
- 10 Plug in *template rail's* LED lights – they will light both hammers and *templates*.

G At Bench: Set Strike to Kissing Samples, Record *Template* Heights and Hammer Spacing Scale

- 1 Now that bedding is correct, set strike heights of templates to kissing samples:
 - a. Make each template just block strike sample hammers with **WNG Dip Tool** on key.
 - b. Fine adjust template (pinch into position) so hammer “lets off” with slight hesitation and secure.
- 2 Place **Regulating Rack** *templates* at strike directly above hammer centers to measure custom bore:
 - a. Place 12” digital calipers on each *template's* top edge and extend depth gauge.
 - b. Measure to center of hammer flange center pin for each sample.
 - c. Subtract 2.00” to produce overall hammer length with a 1.00” tail (*templates* are 3.00” tall).
 - d. Draw overall length on tails and cut them carefully to this line.
 - e. Bore from tails – one setup bores all hammers.
- 3 With *templates* over crowns at strike, secure *slipper track stops* against **Regulating Rack** *feet*.
- 4 Record hammer spacing scale on *template* edges with *black Sharpie pen*:
 - a. With *templates* at strike, mark centers of spaced hammers or sets of wearmarks.
 - b. *Black Sharpie* ink erases from templates easily with alcohol but take care not to mark hammers.
 - c. Employ the Hammer Spacing Scale to restore correct spacing when regulating changes it.
- 5 Record strike heights with **String Height Gauge (SHG)**:
 - a. Set up **String Height Gauge** *rail* behind action, extending *feet* to stand on *slipper track* flanges.
 - b. Position *thumbnut* under *rail* over **Custom Keybed** *bedding support* and spin down to just touch.
 - c. Move **String Height Gauge** on *rail* to position under end unisons for each *template*.
 - d. Release *thumbscrew* and tighten with *plunger* touching *template*.
 - e. Record heights on plunger with *Ultra Fine Sharpie* – erase later with alcohol.
 - f. Or record with automatic center punch (lay **String Height Gauge** on back) for permanent record.
 - g. The 5 **SHG** registration holes are vertically distinct so *plunger* saves 10 unique samples.
 - h. Write on plunger sample note numbers, piano information, and date of work.

H At Bench: Fully Regulate a Natural and a Sharp to Confirm Parts, Materials, and Elevations

- 1 Sharps have different geometry from naturals and making sharp whippen heels 2mm taller can help:
 - a. Sharps at full dip must not feel “buried” between neighboring naturals at rest.
 - b. Cut-punching sharps and naturals to suitable heights: to each other, to key pins, to case parts.
 - c. Use a neighboring natural to run new and old parts side-by-side for comparative analysis.
- 2 Set up half-stroke samples with 8mm or 6mm **Keysteps** (depending on keys-to-keyframe distance):
 - a. Measure full dip and set **Keystep** to stop key at half dip.
 - b. Or take blow-distance **Gauge Key** and use its half-length for half-blow.
 - c. Use **Key Dip Tool** to hold key at half-stroke (take care with balancing on sharp).
 - d. Hook strong thread under key around balance pin and pull tight to whippen center.
 - e. At half-stroke, this line should intersect the contact point of whippen cushion and capstan.
 - f. This information helps choosing parts or calculating geometry changes.
- 3 Check blow, dip, backchecking, springs, let-off, and aftertouch for suitability and balance:
 - a. Regulate to meet normal distance expectations.
- 4 Check for normal upweight, downweight, inertia, and friction.
- 5 If any outcome needs modification, consult the hierarchy of what can be changed:
 - a. Look to the easiest and simplest solutions first.
- 6 Acknowledge what cannot reasonably be changed.
- 7 Try variations of what can until a best solution is reached.
- 8 Validate by specs and aftertouch.

I At Bench: Prepare Parts and Materials - clean, lube, repair, restore, replace, file, ease, pin

- 1 Remove topstack, keys, and keyframe as needed.
- 2 Clean parts and lubricate as needed.
- 3 File hammers, if using existing hammers:
 - a. Number and remove hammers to **Action Tray**, keeping hammers and screws in order.
 - b. File flared sections at drill press with **Hammer Filing Jig**.
 - c. Do NOT file straight-bored sections yet.
 - d. Treat or replace knuckles as needed.
 - e. Refine tail shape as needed.
 - f. Re-pin as needed – 8 to 9 half swings ideal (or 2.5 grams at flange for WNG hard bushings).
 - g. Return hammers to rail and space to *Hammer Spacing Scale*.
- 4 Make repairs to, restore, or replace whippens as needed:
 - a. Pinning may be advisable: repetition levers should not be loose (5 grams at long end ideal).
 - b. Align jacks in windows – assess both jack and rep lever when choosing correction.

- c. Insert a new center pin, bend (no burrs), and push back through to correct.
 - d. File, bolster, or replace materials on heel and rep lever as needed.
- 5 Make repairs to, restore, or replace keys and keyframe as needed:
- a. Polish or replace capstans, glider studs, and keypins as needed.
 - b. Size/reinforce topstack screw holes in keyframe cleats with CA glue.
 - c. Sand away keyframe's return spring indentations with a sanding block.
 - d. Address other condition issues with keys, keyframe, and materials as needed.

J At Bench: Set Up Squaring Platform and Travel Hammers with Shank Traveler

- 1 Extend **Squaring Platform** feet to stand but not bind on the *slipper track* flanges.
- 2 Raise height of **Squaring Platform** so *sliding top* will clear backchecks with keys at rest:
 - a. Set same height at each end, front and back, with *depth/angle gauge*.
 - b. If **Squaring Platform** feet rock, adjust **Custom Keybed's** support to eliminate twist.
 - c. Clamp **Squaring Platform** feet to *slipper tracks* so *support rail thumbnuts* are clear of hammers.
- 3 Travel shanks to vertical with **Shank Traveler** on the **Squaring Platform**, *sliding top* contracted:
 - a. **Shank Traveler** reference edges reach over backchecks and hammerheads.
 - b. Use screwdriver to lift shanks between *reference edges* one-at-a-time through range of motion.
 - c. Use visual comparison to *reference edges* (either side) as shank is lifted through its travel.
 - d. Touch *reference edge* to shank for a tactile assessment of friction during travel.
 - e. If quiet, use aural assessment of shank and *reference edge* rubbing.
 - f. Paper each flange as needed for all shanks to comply:

K At Bench: Hang Hammers Vertically at Strike with Hammer Hanging Jig

- 1 Consider custom boring, when plate bow has strings too high in the middle:
 - a. Hammers with two-tiered boring, if correct at 1 and 88, overstrike elsewhere.
 - b. Tails and backchecks may be too short for good backchecking, particularly in the middle.
 - c. Rest cushions may be too far from shanks to prevent hammer-backcheck collisions.
 - d. Custom trim hammer lengths to reflect these differences.
 - e. All tails can be the same length (bore from tail).
 - f. All backchecks can be the same height.
 - g. All shanks can be the correct height over rest cushions.
- 2 Add **Hammer Hanging Jig** to **Squaring Platform's** *sliding top* with *sliding top's* hardware.
- 3 Extend and adjust *sliding top* to support hammers at strike section by section.
- 4 Plug in **Hammer Hanging Jig's** LED lights for better tail and shoulder visibility.
- 5 Using **Regulating Rack**, lift samples to strike with **Squaring Platform's** *shank support* and secure.

- 6 Adjust *sliding top* so inside of each sample hammer tail just touches *shank support rail*.
- 7 Remove **Regulating Rack** and secure *shoulder guide* to touch rear shoulders of sample hammers.
- 8 Dry fit new hammerheads to shanks (working from behind the action):
 - a. Use tapered triangular file to ream holes from inside of tail.
 - b. This gives tight fit at back, while allowing tweaking room at front.
 - c. Also, the file cuts grooves in the hole, adding surface area to the glue bond.
 - d. Blow all dust out before gluing.
- 9 Glue on hammerheads, using **Hammer Square Lite** and protractor as needed:
 - a. Apply glue to both hole and shank.
 - b. Spin hammerhead onto shank for even glue collar.
 - c. Push hammerhead down shank to approximate position.
 - d. Lower hammershank onto *support* (hammer at strike height).
 - e. Pull hammerhead against *guide*, while pushing tail to *support rail*.
 - f. Check verticality with **Hammer Square Lite** and flare angle with protractor as needed.
 - g. Work quickly – verticality can be refined later when the **Hammer Hanging Jig** is removed.
 - h. Alternatively, dry fit tightly WNG composite shanks, wicking watery CA glue when ready.
- 10 Move *sliding top* and **Hammer Hanging Jig** from section to section until all hammers are hung.
- 11 For highest treble sections, secure **Hammer Hanging Jig stops** to touch *shoulder guide* once positioned.
- 12 Now *shoulder guide* can be withdrawn so shank ends clear when lowered onto *shank support*.
- 13 Slide *shoulder guide* back to stops and secure to validate freshly hung hammers.
- 14 Let glue dry completely, then clamp shanks, trim ends, and sand flush.
- 15 Remove clamps and **Hammer Hanging Jig** and blow off any the dust.
- 16 Alternatively, remove hammers to **Action Tray** to finish tails and check pinning.

L At Bench: Complete Part Alignment and Spacing

- 1 Square hammers to vertical at strike using **Hammer Square** on **Squaring Platform**, *sliding top* extended:
 - a. *Sliding top* clears backchecks at rest, but shanks are up, so loosen well and lift when sliding.
 - b. Secure *sliding top* so there is enough room for the **Hammer Square** to do its work.
 - c. Use a **Medium Lighting Rail** (which matches *sliding top* width) to light hammer squaring.
 - d. Support hammers at strike by their shanks using the **Squaring Platform support rail**:
 - i. Lift **Squaring Platform shank support** so hammers touch **Regulating Rack template**.
 - ii. Tail lengths may vary but flared hammers' crowns must be at strike.
 - e. One by one, test verticality with **Hammer Square**:
 - i. Heat shank and twist into position as needed.
 - ii. Wait for shank to sufficiently heat before twisting.

- iii. Reference hammerhead verticality with **Hammer Square**.
 - iv. Hammer tails may be unevenly tapered and they twist on flared hammers.
 - v. **The ideal:** if there was no glue, hammerheads would balance on shanks at strike.
 - vi. Articulated **Hammer Square** legs turn closer to hammer – leg corners provide references.
- 2 Space hammers to *Hammer Spacing Scale* – final spacing will be tweaked in piano:
 - a. With hammers supported on **Squaring Platform** at strike, space to *Hammer Spacing Scale*.
 - b. Match the center of each hammer to its mark on the *template*.
 - c. Or lift hammers one-at-a-time to *Hammer Spacing Scale* for spacing.
 - d. At regulation's end, erase *template* marks with alcohol.
 - 3 Fine-tune hammer alignment, as needed:
 - a. Check travel with a long screwdriver, gang lifting to compare.
 - b. Mark shanks that are changed and correct hammerhead tilting by eye.
 - c. Or another pass with the **Hammer Square** will touch up those that changed.
 - d. Refine spacing of changed hammers by eye or by using the *Hammer Spacing Scale*.
 - 4 Gang file straight-bored sections now that hammers are vertical:
 - a. Do any pre-voicing first, tails on *sliding top*.
 - b. Support hammers with crowns all at same height (not at strike profile heights).
 - c. Be careful not to round over ends of sections.
 - d. A wide sanding paddle makes the group shape even.
 - e. Use sandpaper strips of useful widths to finish and refine.
 - f. Remove **Squaring Platform** from **Custom Keybed**.
 - 5 Square whippens and space to knuckles:
 - a. Repetition levers to knuckles primarily, heels to capstans and jacks to letoff buttons secondarily.

M At Bench: Regulate Keys and Top Action

- 1 Fine level and dip keys:
 - a. Shanks must be off rest cushions/rest rail.
 - b. **Keysteps** already support natural leveling samples – set sharp leveling samples.
 - c. Pre-level sharps and set sharp **Keystep** leveling samples.
 - d. Place **Key Level Stick** on sharps first, then naturals to level together.
 - e. Remove topstack to add punchings, flip soft punchings to top on the last pass:
 - i. Firmly settle keys and consider key end spacing.
 - ii. First round: square, space, and level sharps and naturals.
 - iii. Second round: fine square, space, and level sharps and naturals as needed.
 - f. Set the initial dip for naturals with **Key Dip Tool** at depth determined by fully-regulated samples.

- g. Dip sharps – by feel replicate sharp-to-natural at-rest key heights near capstan at full stroke.
 - h. Touch up bushing fit, balance hole fit, and keypin lubrication while topstack is off.
- 2 Regulate backchecks (with *holddowns* engaged if frontrail is a crowned fit):
- a. Space and square backchecks to tails.
 - b. Use **Regulating Rack templates** as “strings” to play hammers into check.
 - c. Set natural backchecking as high as possible and match sharps.
 - d. Check backcheck-tail clearance by playing through notes with hand-pressure on hammers.
 - e. Validate checking distance with **Gauge Key**.
- 3 Regulate springs (firm return but no pop – jack return speed may depend on spring strength).
- 4 Set **Regulating Rack template rail** all the way down and do a quick hammerline:
- a. Press hammers hard against *templates* to settle knuckles, heels, and balance punchings.
 - b. Press back of keys to settle backrail cloth and front of keys to settle frontrail punchings.
 - c. Hammerline must just “kiss” *templates* as pressure affects neighbors through backrail cloth.
- 5 Regulate jacks to knuckles (do this from back of action):
- a. Shine **Lighting Rail** from keys up into top action, lighting the jacks.
 - b. Depress neighbor repetition lever, sight down knuckle to jack and adjust jack.
 - c. For speed and consistency, set section samples and reference front of jacks to a straightedge.
- 6 Regulate repetition levers to jacks (winking):
- a. Place LED-lit **Regulating Rack templates** slightly behind hammerline for visual reference.
 - b. Feel and see winking. And make sure jacks completely reseal on a soft return.
- 7 Refine hammerline as needed – re-settle action’s compressibles and touch up hammerline.
- 8 Regulate letoff – raise *template rail* to strike and lower to letoff with **Gauge Keys**:
- a. Release and tighten *thumbnuts* at the front of the *template rail brackets* for each position.
 - b. Use thickest **Gauge Key** in bass and thinnest in treble to taper letoff clearance for whole action.
- 9 Regulate drop so that aftertouch will bring hammer no further than letoff.
- 10 Weigh off action to both downweight and upweight (match speeds):
- a. Choose downweight and upweight specs to give clear key response speeds.
 - b. Remove enough lead from keys to weigh off in one round.
 - c. Drill out holes left by lead removal to 9/16” and plug.
 - d. Trim plugs, blow out dust, and assemble action.
 - e. Place leads on keys to match upweight and downweight speeds.
 - f. Slower or faster combined speeds indicate frictional irregularities: troubleshoot and solve.
 - g. Drill for and install leads – opposite side from key flare enhances stability.
 - h. Clean keytops, lube keypins, and paint sharps as needed.
 - i. Damp-chaser additive soak balance holes on keypins overnight.

- 11 Touch up key level and hammerline.
- 12 Regulate aftertouch by dip: depress multiple keys at a time to compare and make even.
- 13 Touch up backchecks, springs, hammerline, drop, and aftertouch as needed.

N At Piano: Regulate Dampers and Pedals, Mate Strings to Hammers, Tune, and Voice

- 1 Install action and validate balancerail bedding with **WNG Keyframe Bedding Tool**.
- 2 Settle wire on hitchpins, duplex, and bridges (go gently on speaking side).
- 3 Insert return spring and square as needed with front punching shims.
- 4 Install action and fine space hammers (and strings in Capo sections if needed):
 - a. Wedge keyframe out to align bass side of a hammer to its bass-side unison string.
 - b. Space rest of hammers, bass sides of hammers to bass-side unison strings.
- 5 Pitch raise and tune – strings need to be at pitch and fine-tuned at conclusion of mating.
- 6 Mate strings to hammers by pluck and lift until all strings mute – retune as needed.
- 7 Shim back action side-to-side, then tighten, square, and space underlevers.
- 8 Ease guiderails, then travel, square, and regulate dampers to keys.
- 9 Optimize trapwork, then regulate tray lift, pedals, and stops.
- 10 Voice, refine string-to-hammer fit, and retune as needed.

Note:

Once the *templates* are set up to represent string heights along the strike line, the information recorded on a *plunger* from those heights can be used to make a *whole action template*. For pianos regulated often, you can set up one *template* with a permanent *Hammer Spacing Scale*, using only two string heights off that plunger.