Grand Action Regulation

Let the Action Speak for Itself

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- Who decides the standards?
- Who decides to do the regulation? The owners, who don't necessarily understand piano regulation.
- What are we trying to improve by regulating?
  1. **Control**: evenness & dynamic range
  2. **Power**: efficiency of the action, good energy transfer
  3. **Reliability**: repetition

We need to decide what's the priority of the job today?
Rather than pointing out flaws in the piano, we need to talk to customers about what is meaningful to them by asking questions. Some possible questions are:
"Do your students ever complain about your piano?"
"What's the reputation of your music department if youor pianos are falling apart?"
"How is the range of expression of your piano – playing soft and loud?"

Power Chart

Ideal Power Output = Volume as compared to Playing Level

- If the let-off is low you can't play pianissimo
- If the let-off is too great you can't get the full power
- If the back-checks are too close/high, the capstans and hammers are probably too low, causing the tails to drag on the back-checks. Flat knuckles can also cause this.
- If the jacks have too much resistance, it's hard to play smoothly.

No matter what problem in the action, the result can be thought of as poor tone, reduced dynamic range or slow repetition.

Circle of Refinement

- Beginning technicians want to have a simple, step-by-step process to follow.
- Unfortunately, this isn't possible. There is always re-checking to be done, since everything relates to each other.
- The best way to do anything is to do it fast twice rather than to do it once perfectly.
- In the factory, the less-skilled technicians do everything once to get the rough work done.

Evaluate Condition of Action

- Friction
  - Check keys, center pins
  - Determine how much time you have to fix the issues
- Action Centers
- Wippen Cloths
  - Push a needle sideways through the whippen heel

    - When the heel gets compacted it becomes a ball and socket and creates a hard start-up
    - Another way is to drop alcohol and water into the depression to make it swell
- Key Bushings
    - Ease keys if they're too tight
    - If key bushings are compressed, they can be needled
    - If it's worn, don't needle: it will tear the cloth. They should be replaced.
    - When you feel side-pressure roughness when the key goes down, lubricate or polish the rail pins
    - If all these other issues are addressed, consider installing a touch rail.
- Key End Felts
    - Needling the end felts can bulge up the groove.
    - McLube 444 from Schaff has a shoe dauber attached to the lid. Buy a gallon from McGee Industries, the manufacturer who makes McLube. They also sell the solvent (don't breathe it: very toxic).
        - Don't put it on plastic because the solvents
        - Apply McLube on key bed, key pins, key frame, key bed spring, capstans, on the bottom of damper levers
        - If you use it too much on felted areas, it will pack the felt down, because when it hardens it's sort of like heavy paraffin wax.
        - Don't combine McLube with graphite, because together they will squeak.
        - It does work with Teflon-coated jacks.
- Key Frame Felts
- Knuckles
    - If you have a heavy touch, squeeze the knuckle. The core cloth doesn't wear out.
    - Bulging the jack out will tighten the skin. Needle rather than bolstering, which can be irregular and not precise.
    - Bang on all the keys for a minute to compress everything that had been needled.
- Hammers
    - Hammer line and strike gets higher with time, so gradually the hammers become over-centered.
- Back Checks
    - Worn back-checks can be filed with sand paper or dragon skin, especially if the tail has dug into the leather. Don't file off the leather; just smooth it so the interface works.
    - Sometimes you can get rid of the edge of the hammer tail.
    - Adjust the position of the back-check.
- Touch Weight
- Repetition Lever Coating

Tools

- Long straight edge
- Split screwdriver
- Fine regulator
- Medium screwdrivers, both Phillips and blade
- Small ruler

- Key leveling weights
- Key prop for leveling
- Damper lever height gauge
- Let-off rack
- Key Dip Block
    - (Kawai makes nice ones)
    - All the manufacturers make their own blocks
- Suede brush
    - Use to un-polish knuckle skins if they are too shiny
- Regulating Gauge
    - Make a wire gauge a little big and then file it down to size
        - Wire or plastic
    - Measurements
        - Blow 47mm
        - Bakck check 15mm
        - Damper lift= half blow
        - Wire 2mm thick for let-off
- Drop screw/jack regulating driver
- Flange spacer
- Let-off regulators
    - 90 degree dome
    - Short pin
    - Star ratchet
- Back-check wire bender
- Balance rail glide tools
- Key support bar
    - For leveling keys in the piano
    - $1/8^{th}$ inch rod bent into a D, bent up at each end 1-1/2”
    - Add sprinkler tubing on the ends
- Action support
    - Many of the newer pianos already have holes drilled in them
- Tweezers
- Key spacing tool
    - Use deburring wheel for ends and round the corners so as not to scratch the pin
    - Straighten pins that have been turned
    - Re-bush keys if they are too worn
    - More friction is more drag
    - Space the keys left and right to make them look even
- Capstan tool
- Key-frame Glide Tool
    - Schaff sells a key frame tool that will fit the hidden glides from Kawai
    - Joe Goss makes a screwdriver with a tube over it

Supplies

- Paper punchings
- Travel paper

- Sandpaper sheets
    - Wide for sanding key frames
    - Cover back with packing tape
    - 220 grit
- Hammer filing strips and/or paddles
- McLube 444A
- TFL-50 or Slide-All
- Fine Teflon powder

Pre-Regulation

- Tighten screws
- Reface hammers (twice)
- Clean action and key bed
- Polish capstans & key pins
    - Buckskin burnishes metal and removes oxidation
    - Make a stick with a split on one side, covered with leather and straight leather on the other end
- Bolster & Brush, or replace knuckles
    - Instead of yarn, use kite string: remove two of the three strands
    - Jim Harvey would peel off the leather, ull it and clamp it to tighten the skin
    - Replacing is easier
- Ease keys
    - Balance holes
        - Pick up the key and it should slide back
        - Balance holes get tighter in dry conditions (the opposite of tuning pins)
        - Verify the humidity with a gauge
            - Dry make it tight
            - Wet make it fall freely
        - Ease the hole with the tool
            - With Chinese tools make it flat all the way out to the tip
            - The tapered tool can be lightly spun to flare the top of the hole
            - If the hole is too deep, it can be milled with another tool
            - The hole should be about 3mm
            - Use the table as a depth gauge when drilling
    - Bushings
- Square and space keys
- Apply Teflon powder to knuckles
- Apply McLube to key- frame and key-bed
- Apply TFL-50 to key pins

The Three D's:

1. Dip(11mm to start)
2. Drop
3. Dancing

Location and Alignment

1. Action Location
    a. Test trike point
        i. Set key frame guide
        ii. If the treble and bass don't mess, check the cheek blocks and decide if the stop block needs to be shimmed
    b. Examine the left-right location
    c. Examine the treble for sound
        i. The action can be moved, or hammers can be moved
        ii. Look at key frame front edge
2. Bed the Key frame
    a. Turn up the balance guide rail screws until they knock
        i. If you get lost where the screws are, feel for key movement. Every little shake of the key is amplified at the key fret If the screws are up high and it's not knocking, put your finger under the key, squeeze push down on the screw and you'll feel it with your finger under the key.
        ii. If the screw is too down and it's tight, raise the screw up so it knocks
        iii. You can't feel the hidden ones until they knock
    b. Turn the screws down until they feel smooth
        i. Don't keep turning them farther and farther down
        ii. Knock the balance rail, turn down a little bit
        iii. On big pianos, push down on the pedal and see if they still knock because the lyre will pull down the key bed a little
    c. Test by lifting up on the hammer rail and knock on the keys to see how much lift it takes to make a knock.
        i. The end ones are always easier to lift
        ii. On every tuning, check the lift
    d. While they are raised, set the front and back glides
        i. Through the strings, engage the screw and check the back rail
        ii. The return can bounce more and the action cannot return as well
        iii. Play a hard bass note and you can see all the hammers bounce if wrong
        iv. If you do have to do a lot of bedding, you will check the stack off
            1. When replacing it, check the feet.
    e. Front rail
        i. Put your finger tight in the corner on the key frame under the key and you can feel any tapping
        ii. Some pianos should be flat at the front rail
        iii. Others are bowed upwards at ends, clamped down with cheek blocks
        iv. On Kawais, in dry weather the ends might start to lift a little
        v. In humid weather flat, in dry weather lift: turn the adjustment screw in the cheek block, with the key slip in.
        vi. A little light pressure will keep it changing with the weather.
    f. Set balance rail glides down to eliminate knocking, support rails for best power
        i. Start at tenor break
        ii. Do bass, recheck tenor, then move u to treble

iii. Recheck back and forth for no knocking, even pressure. Test by lifting on hammer rail
iv. Set hidden glides (if any) last.
v. Turn it down until it doesn't knock. Then turn it up a little.

3. Level Keys
    a. For actions with ½ round dowels at balance rail, level keys with stack off using weights on back-checks
    b. For others, use split punchings, insert from the front with the action stack in place.
        i. Technique
            1. By drawing the action onto the action support and sitting on the floor, examine the heights.
                a. Tap with straight edge to find and fix high ones.
                b. For low keys, put the punchings on the key-frame for insertion later.
                c. Using the Spurlock key lifter, insert the bar for access
                d. Wiggle the key and raise the felt on each one that needs a punching
                e. Pull it out, put in the punching, push down the felt
                f. If a key is only slightly high, place a key-push tool on the key button. Lever against the pin-block by adjusting the capstan, and push down on the key pin. It slightly compresses the punchings.
    c. Tools: pre-slit punchings cut with center pin nippers, comfortable tweezers, capstan wrench
    d. Key height
        i. How high should the keys be?
        ii. Reference points in the piano:
            1. Case parts
                a. Original key stop rail
                b. Key slip
                    i. Kawai key slips sit close to the keys
                    ii. Other pianos are far out
                    iii. Shouldn't be able to see under the keys
                    iv. Front of the key should be roughly a square
                c. Cheek block
                d. Key slip
                e. Pin lengths
                    i. Must engage on the front rail pin
                    ii. Balance rail should stick up above by 2-3mm
            2. Alterations
                a. Did someone change the backrail cloth thickness?
                    i. Keys are designed when they are played level.
                    ii. Pulling on the key when it goes down is more controllable, gets better tone quality and is easier to play than when it goes down too deep
                b. Did someone change the key tops?

i. Check the thickness of the name board felt
ii. Try to make it work with what is there.

4. Space and Travel the Action
    a. Hammers
        i. Travel first
            1. Use lick and stick tape
        ii. Align shanks & hammers
            1. Spacer tool at stop block
            2. Off-set the hammers slightly to the right. Kawai does 1mm on the left
            3. Yamaha centers their hammers
            4. Set a sample hammer
            5. Use a temporary shim.
                a. Stick a mute in by the action, ease the key in until the top of the hammer shows.
                b. When you can see it right on the edge, you're not guessing
        iii. Place a felt strip under the knuckles
    b. Travel and space whippens
5. Align Back checks
    a. With the hammer in check, tap down on the hammer and it should move down
        i. If it is too tight, the hammer won't move down
        ii. If too loose, it will fall quickly
        iii. If the back check is too vertical, put the tool over the head and bend the wire slightly back
        iv. Do the first and last of each section, play and check them so all the samples feel the same
        v. When the samples are good and consistent, in a quick pass adjust all the others by feel and visually
        vi. Go back and fine adjust them with a straight-edge
        vii. Adjust the back-checks side-to side in line with the tails.
        viii. Stick a mute on the string to see if the hammer checks better
            1. By stopping the string and playing it drives the energy back into the hammer
            2. If the hammer still bounces, adjust the back-check
6. Action Spread
    a. Doesn't apply to Kawai actions: fixed spread
    b. In others, look for evidence that wippen rail has moved
    c. Wood actions have slots where the screw had clamped, and it might be loose.
        i. Look for clamp marks
        ii. Look where the jack is aligned to the knuckle.
            1. Is the jack perpendicular to the shank?
            2. Often whippens have a mark on the top or side as a guide
            3. Look at the screw marks on the rail
        iii. Set the blow distance
        iv. Set the jack to the knuckle, which has Teflon on it
        v. Make sure let-off is close

vi. Measure down- and up-weight and subtract the difference to find grams of friction.
vii. Loose the screw, move the rail, and tighten it.
1. Start by testing a sample flange until you find the right spot
2. Measure this distance with a caliper
3. Move the rail so that the entire spread is moved.
viii. Re-check the capstan and down- and up-weight.
ix. This move lowers the friction without lubrication. The friction level will have a dip at the ideal spot.

d. Check with a caliper if you know the spec
e. D

7. Space Jacks in Repetition Levers
a. ABS wippens need very little, but they still must be checked
b. Tapping jack works for minor adjustments
i. Tapping
1. Support the side of the wippen the jack needs to go towards
2. This slight bend in the center pin can lead to trouble
ii. The right way is to align jacks
1. Re-pin
2. Push the pin so it is just coming out the other side of the bushing
3. Grab the other end of the pin with your cutters and bend the pin right at the bushing, between the birds-eye and the bushing.
4. Look at the top and spin the pin. It will turn like a cam. When the jack is in the center, cut the pin at both ends. As long as it is well-fitted in the birds-eye, that pin will stay.

Heart of the Regulation

8. Regulate Jacks to Knuckles
a. Rear edge of jack align to rear edge of knuckle core wood
i. Turn the action around
ii. Push the rep lever down
iii. Look down from the top
iv. Examine the row from the side
b. Evenness is very important
i. Kawai jack tops have a slight twist to them
ii. Kawai is very consistent
c. Some actions must be checked on every note, as knuckles are not quite in alignment
9. Set Repetition Lever Height
a. Feel for slight edge of rep lever window
b. Each action is a little different how deep they feel
c. Find one with good spring regulation, then check that the jack is touching the knuckle skin at rest, and will return on its own when released. The hammer should wink and the jack should return.
d. Use the
10. Set Let-Off in Piano

a. Goal
    i. Closeness depends on quality of piano, frequency of service, importance of the best tone and control of touch.
    ii. Practice feeling let-off buttons, keeping eyes on string/hammer contact
b. Technique
    i. If you have a pin-type, practice on a wood or Renner action. Kawai flares out the hole.
    ii. Use a short-handle tool that fits your hand. Place your finger on the end of the tool so it can feel the next hole.
    iii. Lean over the piano with a head lamp on and eyeball the adjustments.
    iv. In the bass, with the foot on the pedal lifting the dampers, you can look underneath.
    v. In the treble, the dampers are generally just under the hammers.
    vi. In a really fine regulation, the let-off should be the thickness of the wire, which is .8mm at treble, 1.2mm at break
    vii. Stick rubber magnets under string
    viii. Use a gauge that measures both .8 mm and 1.2mm. Your eyes need a reference point so you can recalibrate your estimates.
    ix. Reasonably close is good. The goal is evenness.
    x. Use good light.

11. Determine Best Blow/Dip/After-Touch specifications
    a. After-touch
        - What is after-touch?
            - To pianists, different than to technician
            - Feeling or measurement – jack drag on kunckle
                - Is the motion after the key is depressed. If it is jamming against the stop felt, there is a lot of stress on the jack. A two-part jack will come apart. With no extra clearance, it won't repeat. Aim for a point between the dip and the blow.
        - How much is needed? Which specification is the most critical to pianists?
            - Key dip? Blow distance? After touch feel?
            - Kawai & Yamaha, regulate to the factory specs
            - There is a range of touch & dip
                - Minimum 3/8", maximum to 11mm
    - Procedure
        - Set sample note to manufacturers' specs, if you know them. Otherwise use a general starting spec to evaluate. Often black keys and white keys are different.
        - Make an after-touch gauge for a particular piano.
            - Put punchings on top until the hammer squeezes against the string
            - How much you pus h on the punching is variable
            - Get rid of the buzz with a medium pressure
            - When we get to the key dip, we can put this on the punching it should go click and fall through.
            - For particular pianos, label that punching or gauge.
            - You will have the ideal depth for the black keys as well as white.

- Add new punchings with the gauge on top of the felt until the touch is right.

12. Regulate the capstans
13. Adjust the drop screws
14. Regulate the key dip
15. Regulate back checks
16. Adjust the repetition springs
17. Re-check the regulation
    a. Rep levers
    b. Capstans
    c. Drop

Dampers and Pedals

18. Regulate damper lift
    a. From key
    b. With pedal
19. Regulate damper up-stop rail
20. Adjust the sostenuto
21. Adjust the una-cord
22. Check damper function