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Grandwork™ Alignment Protocol

For Simplest Energy Delivery and Reset

Principles:

1. **Direct opposition to gravity (verticality) maximizes stability and minimizes complexity**.
2. **Take plane of keybed as the horizontal index for referencing vertical.**
    a. Since pianos can be reoriented, keybed as horizontal index best covers the possibilities.
    b. Ideally, level the piano so keybed is perpendicular (tangent) to the pull of gravity.
3. **The direction of key travel should be vertical at full dip (and keytop surface horizontal).**
    a. The player's finger follows an arc that, with the key's arc, complicates past this point.
    b. The key goes down to horizontal as the hammershank comes up to horizontal.
    c. The plane of those arcs is simplest when perpendicular to the keybed.
4. **The hammer crown's motion starts vertically, but travels around its arc toward the player.**
    a. The plane of the hammer's arc is also simplest when vertical.
    b. Its bounce will then want to go vertically back the way it came.
5. **Square hammers for strike, not for clearance, and custom bore for regulation consistency.**
    a. In flared hammers, far shoulders effectively weigh more than near.
    b. And since far shoulders travel a wider arc than near shoulders, they accelerate faster.
    c. "Squaring" for clearance tips flared hammers toward far shoulders.
    d. Increases in force (and speed) exaggerate discrepancies.
    e. Tipping changes spacing with increased force to lose most power on the hardest blow!
6. **A piano's strings will not necessarily be in simple planes or parallel to the keybed.**
    a. They rise slightly to their bridges (different amounts in different parts of the scale).
    b. They often crown bass-to-treble with plate crown, highest in the middle.
    c. Planes of agraffe and capo may not match bridge surface planes.
    d. If unisons twist to the bridge, the one spot parallel to the keybed needs to be at strike.
7. **Best tone, power, and repetition (TPR) happen with the simplest transfer of energy.**
    a. Travel and square to vertical for greatest stability-to-friction ratio.
    b. Appropriate and consistent friction enhances stability, repetition, and tone.
    c. Unison strings should be horizontal side-to-side at strike, i.e., parallel to keybed.
    d. File hammer crowns perpendicular to moldings and square them horizontal at strike.
    e. Parts rising vertically to strike horizontal surface to horizontal surface return vertically.
    f. Mate and level in one operation, fitting strings to vertical-at-strike hammers.
    g. No underlifted or overlifted strings stabilizes tuning and mating.
    h. Complete the mating with all strings at pitch AND in tune.

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Keybed, Keyframe, and Keys (do part replacement and structural changes first):

8 Clean keybed (remove glue drips, overspray, and debris) and repair/dress surfaces as needed.

9 Bed keyframe (keys as-is), sample, and set up on bench for squaring, spacing, and leveling.

10 Fine position keyframe for soft pedal and tone when action returns to piano.

11 Key pins (key travel) should average out to be vertical when key spacing is finished.

12 Keys must fit within case parts and have enough front pin in key and balance pin out of key.

Action Frame, Hammershanks, and Hammers:

13 Action frame rails should be horizontal and bracket feet fit to cleats with keyframe bedded.

14 Travel shanks to vertical with Shank Traveler (vertical) on Squaring Platform (horizontal).

15 With crowns at strike, square hammers to vertical with Hammer Square on Squaring Platform.

16 Space hammers at strike to scale drawn on Regulating Rack from wearmarks or pre-spacing.

17 Custom bore hammers to variations in strike height to minimize regulation compromise.

Whippens and Backchecks:

18 Pin repetition levers then jacks: insert new pins, bend, and push in to precisely position parts.

19 Align repetition levers to knuckles, cushions to capstans, and tenders to letoff buttons.

20 Repetition levers exactly, capstans and tenders reasonably, overall vertically.

21 Square backcheck heads to vertical and center on tails when in check.

Weigh-off and Touch-up:

22 Insert leads flush to far side of key from flare for best key stability.

23 Refine fit to key pins, then refine squaring, spacing, and leveling.

24 Fine adjust action stop, shimming to best side-to-side positioning overall.

25 Fine adjust in-out positioning at cheekblocks for best tone (most sensitive in high treble).

26 Refine topstack regulation, fine-tuning aftertouch (overall internal action alignment).

Strings and Dampers:

27 Pre-lift all wire to just stabilize underlifted strings (will not change strings that are stable).

28 Refine spacing of strings, guiderails, and hammers as needed.

29 Settle wire judiciously to relieve spring affect and even up angles of address.

30 Raise pitch as needed for the settling to produce stability at pitch (don't oversettle).

31 Lift wire to fit vertical hammers at pitch – unisons will be parallel to keybed.

32 Travel, square, and space dampers to now-leveled and well-spaced strings.

Pedals, Trapwork, and Case Parts:

33 Adjust pedal and trapwork connections to minimize rubbing and possibilities of a squeak.

34 Tweak pedal positioning so all three pedals are at the same appropriate height.

35 Space case parts, hinges, and fittings for alignment, evenness, and ease of engagement.

