Getting It "Concert Ready"
and keeping it that way

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The concept of "concert prep" in this class is somewhat different from the usual. Most concert prep classes deal with a scenario of the day of the concert, or perhaps a couple days in advance, looking at how to assess an unfamiliar situation and bring the piano to the top condition possible in the time available. This class looks at a larger picture. It assumes the piano is under your care, that adequate time is available, and that the piano needs to be brought up to a high standard from which it can be refined and tweaked as needed. We will deal with several aspects that are often considered to fall under reconditioning, to lay a solid basis for refined work in the realms of regulation and voicing. The techniques outlined in this class are my standard procedure when going through an action, annually for concert instruments, every two to five years for other high use, high expectation instruments, depending on priority and use.

This class was developed from the point of view of a college and university technician (CAUT). Working in a CAUT environment is different from standard home service in three ways: there are very high standards, the pianos generally are very high use, and there is limited time available to service the instruments. So we need to cultivate techniques that achieve the highest standards as efficiently as possible in terms of time and effort expended, and that prolong the life of our work and of the pianos themselves and their parts. Our principles are Excellence, Efficiency and Longevity. These techniques and principles can be applied to any piano, but they are especially appropriate to CAUT and similar situations.

Some general comments:

Friction is a major factor in longevity of piano action parts, and of the work we do. This is true at any point where metal rubs on felt or wood (key pins against bushings, capstan against wippen cushion, repetition spring against repetition groove, centerpin against center bushing, drop screw against repetition leather or felt), as well as other rubbing interfaces (knuckle against jack/repetition, jack tender against letoff button felt). The more friction there is, the more the felt will be compacted and its fibers will be broken and disappear. When this happens, regulation changes more rapidly, and parts need replacement sooner.

On the other hand, these interfaces need to be firm and free of chatter to the extent possible, for a good feel and function. So we need to pay close attention to precise sizing, and we need to try to keep surfaces smooth and lubricated as appropriate.

The precision with which moving parts move relative to one another and relative to gravity has a large effect on function and longevity. This is particularly true of the hammershank and hammer. If the shank isn't set up to move precisely up and down (travel), there will be chatter, vibration of the hammer as it moves up to the string and as it rebounds. Similarly, if the hammerhead isn't aligned (squared, "burned") so that its weight is evenly balanced relative to the shank, a chatter or side to side vibration will occur. Either of these conditions will lead to more wear of the hammer surface, the

centerpin bushings, and possibly the knuckle and other parts as well. Excellent travel and squaring are also an important component of voicing, so attention to these details yields additional rewards. Firm centerpinning is a necessary foundation for these factors.

The act of voicing hammers is destructive to some extent, as inserting needles into the felt not only spreads the fibers apart, but also tears fibers to a greater or lesser degree. There are techniques that can yield good tonal results without causing as much destruction.

A succession of standard procedures for prepping or conditioning/reconditioning actions

Keys/Keyframe/Keybed:

Keypins

The pins must be free from any nicks (replace any nicked pins), slick, and free from corrosion. Polishing is time-consuming. If the pins are in good condition, I prefer to simply apply McLube with a pipe cleaner, bent so that it coats both sides of each pin at bearing areas. (A lubricant can also be applied rapidly using a brush). Replacement with WN&G anodized aluminum pins is an excellent alternative, as those pins will retain their polish and won't corrode.

Key balance holes

Most methods of sizing these holes deal with keys individually. It is far more efficient to deal with the whole set of keys, using a standard method for each key. First, the hole should be just over the size of the key pin, by about .001". This can be accomplished easily using a parallel fluted reamer of that size (.147" for the most common pins, other sizes as needed. McMaster-Carr http://www.mcmaster.com/ is a good source, about $15 each). A rubber band wrapped around the shank makes a twirling motion with the fingers very easy. Insert the reamer into each hole in turn, and twirl. One second or so per key.

The depth of the hole (thickness of the wood through which the hole penetrates) should be established at about 3 mm, using a balance hole reamer on all keys, while they are held either in key clamps, or individually. The holes should also be tapered using the usual "easing" tool (inserted from the top), by establishing how far the tool needs to be inserted, and then fixing the fingers of the hand to limit penetration to that amount. All keys can now be tapered quite precisely without placing each key on its key pin to check (a loose key pin can be used to check all the balance holes very rapidly). Details of sizing procedures can be found in my article in the December, 2007 PTJ.

Key bushings

The relationship between key bushings and key pins is of enormous importance to the feel and responsiveness of an action. Keys must be very firm (no wobble), but completely free (absolutely minimal friction). Maintaining this condition requires lubrication and various sizing and conditioning techniques.

Key bushings should be lubricated from the very beginning. When installing bushings, Teflon powder can be applied to one side of the bushing felt before gluing it in place. [Choice of felt thickness is extremely important when replacing bushings. Fortunately, we have a good selection available these days.] With existing, new bushings, Teflon powder can be applied to bushings using a pipe cleaner. Application should usually be followed with an iron, as the fibers of the pipe cleaner disturb the fibers of the bushings and create temporary high friction. Ironing sets the surface fibers and makes them smoother and more precise.

With adequate lubrication, actual wear of the bushing felt is minimized, but it will still compact with use, leading to wobble. This can be corrected periodically (bushings resized to match the key pins) by steaming and ironing. Keys are placed in key clamps. A steamer is used to apply enough steam to swell the felt, not enough to loosen the glue joint. There is usually plenty of wiggle room between enough to swell and the amount needed to loosen glue. Steaming is followed immediately by a heated, thermostatically controlled bushing caul of the correct size. I use a Conair portable steamer (intended for clothing), about $35 at Target. About 2 – 3 seconds per bushing suffices (this is not enough time for glue to soften and penetrate the felt). As a rule, I move the steamer over a number of bushings fairly quickly (one second per bushing), then repeat once or twice. I do a key clamp worth of one bushing (front or balance) at a time, and follow with the caul, a quick insertion of less than one second. Insert the caul corner first, to avoid dislodging any bushings. When all bushings have been treated this way, I go through each bushing with the caul again, about one second each.

Alternately, VS Profelt (from Pianotek) can be used for re-sizing in conjunction with cauls. I find it takes more time and produces essentially the same results.

Use of firm, highest quality felt, and lubrication and ironing of that felt, leads to the best results.

Done on a regular basis, every one to three or four years, this process of lubrication and resizing takes less than an hour, and contributes a great deal to the foundation of the action, its feel and responsiveness. With experience, the keys can be dropped back onto the keypins with no need to do more than a bit of spot-checking for sizing issues. To check for friction-free fit, use jiffy key leads placed on the back of each key so that it just balances. Then check the key for complete freedom of movement without any drag (lightly tap the key in either direction with a fingertip). No need for gram weights. No significant friction is acceptable (the heavier keys in the bass will move more sluggishly due to inertia – key leads).

Over time, the bushing felt will likely become hard, and will need to be replaced, but steaming and re-sizing can be repeated three or four or more times, if the heat of the cauls is carefully controlled.

Capstans

While dealing with keys, the capstans should be polished and lubed. I wipe Flitz on all capstans with a rag, follow with a scrubbing motion with the same rag, then with a polishing motion with a clean rag. This usually takes less than five minutes for the whole set. I then apply McLube with a rag or pipe cleaner. WNG anodized aluminum capstans will make this unnecessary. I am not so much worried about the feel of the possible

friction, as about wear of the wippen cushions, which leads to more rapid change in regulation (the hammer line drops).

Key end felts

We often find that key end felts on heavy use instruments end up with deep gouges. This condition, and the regulation and function issues associated with it, can be avoided or postponed by lubrication. I start by removing dirt and dust with a brush, and follow with Teflon powder and a clothes iron. I also check the bottoms of the damper underlevers for roughness or friction, and dress with light sandpaper and lubricate as needed.

Keybed and Keyframe

While dealing with keys and keypins, the keybed and keyframe rails (front and back, the portions that actually contact the keybed) should be thoroughly cleaned, and sanded lightly as needed for smoothness (120 down to 400 paper on bearing surfaces). I like to apply and rub in powdered Teflon, or apply Mclube, as well. Glides should be treated as capstans were above, at the same time. The side of the keyframe that bears on the return spring should be cleaned, sanded flat if needed (the dent removed), and lubricated at the bearing point(s) with McLube.

Action

Centerpinning

Like keypins and keybushings, centerpins and bushings need to be firm and free at the same time. Tolerances are much closer, though. Firmness is of more importance than friction in assessing the condition of action centers, especially for hammershank flanges. Friction is affected by the condition of felt and pins, and possibly by residues and foreign substances. It is quite possible to have excess friction, and still have spongy and unfirm centers.

When repinning a set of hammershanks, I prefer to avoid any reaming/removal of felt if possible. I would rather compact the existing felt further. Reaming (even with Mannino reamers) raises fibers, and temporarily raises friction levels. Following heavy use, those friction levels drop rapidly, and firmness also becomes less. I prefer to rely on burnishing to the extent possible, using the burnisher in a rapid and repeated way so as to create heat. The rapid movement plus the heat will cause additional felting action in the fibers of the bushing, getting them to interlock more tightly and firmly, and thus making the opening for the pin somewhat larger. Remember we are talking about diameters of .005” or so (if it is too loose to begin with, and a half size larger pin is too large, the “hole” needs to be enlarged about half a half size). Following burnishing, I always lubricate with Protek CLP prior to inserting the pin. This process yields a firm but free center which will be stable over a considerable length of time.

An efficient process requires consistent placement of tools and supplies, and practiced, consistent movements. Remove the screw using an electric screwdriver. Place the screw immediately on a neighboring flange, where it won’t roll and will be ready to hand for replacement. Remove the centerpin. Burnish the bushing with the appropriate sized burnisher, using rapid back and forth action to create friction and heat, to pack the

felt more firmly. A standard number and speed of back and forth strokes will usually serve to go up to the next half size of pin. (If not, a minimal use of a Mannino broach, followed by rapid burnishing may be used. In either case, one should come up with a set procedure, number and speed of strokes to achieve success with the large majority of flanges – there should be next to no "custom" work). Protek CLP should be applied to the felt before inserting the new pin. When replacing the flange on the rail, finger-start the screw, then drive the screw using the electric screwdriver, with a clutch to keep from over-tightening.

Summing up, by using burnishing instead of removing felt, the center will be firmer and the sizing will last much longer. The lubricant will also help longevity.

Wippen

Normally, the only treatment needed for a wippen in this "frequent recondition" process is to address cushions and repetition leathers.

The wippen cushion will typically dent over time where it contacts the capstan. Reversing this denting by brushing and/or steaming is usually pretty temporary, leading to regulation instability (falling hammer line, loss of aftertouch). The best procedure I have found begins with brushing (or possibly light sanding, if needed), to remove dirt and transfer of metal from the capstan. I then apply water lightly with a paintbrush, and iron using a clothes iron. The combination of moisture, heat, and pressure leads to firm compaction of felt to a smooth surface, which is more stable from the point of view of regulation. Finally, I apply Teflon powder to reduce friction, and delay denting of the felt from use.

I like to apply Teflon powder to the repetition leathers with a pipe cleaner. Sometimes friction builds up there leading to squeaks and occasionally to malfunctions.

Letoff Button

The letoff button felt will typically develop dents with wear. These dents make it very difficult to get a refined and stable regulation of letoff. To avoid this problem, I like to apply Teflon powder and iron new felts. Felts that are already dented can sometimes be flattened by ironing, preceded by brushing some water on the felt. When steam ironing isn't enough, a little sanding can bring the felt of the whole button to an even level. It must then be steam ironed (brush on water, then iron with a clothes iron or a key bushing iron). This process takes maybe five minutes, time which is more than made up in ease and speed of regulation later on. (Severely dented punchings should be replaced: it takes very little time, but more time than sanding and ironing).

My article in the April, 2008 PTJ details some of the above procedures.

Hammershank

Knuckle brushing, and application of Teflon powder, are very common procedures. I find it most efficient with the hammer heads on the work bench, knuckles up, action frame rotated out of the way.

Traveling

While the action is in this position, traveling can be done efficiently and in a very refined way. Please see my article in the November, 2008 PTJ for details. Fine traveling is very important for longevity of parts, and as a basis for voicing. It is also essential for squaring the hammers to the shanks (burning shanks).

Hammer squaring

For refined voicing, hammers must be glued to the shank at the correct angle so that they will be perpendicular to the string when they strike it, which is the same thing as saying that the mass of the hammer arcs directly upward from rest to the striking point, centered on the hammershank. I will refer to this as "squaring the hammer" to the shank.

Refining this angle is done by heating shanks and twisting them. The most precise and efficient method I have found begins by raising a hammer between its neighbors so that the shank is level with the crowns. Center the shank (plus hammer molding) between the two crowns, using a flange spacing tool if possible, or loosening the screw and retightening if necessary. This must be done very precisely, with the eye positioned so as to sight exactly between the two crowns, at the same angle as the hammers are hung. You should not see more of the side of one hammer than the other. The eye can judge quite well when the distances are equal. A dark backdrop is helpful (a fallboard works well). The hammer being raised must be held in place with a very light and sensitive touch, so that it isn't being forced to one side or the other by the finger.

Then drop the hammer to resting position. See whether its crown is centered between the neighboring crowns. It will be pretty obvious if it is not. Heat the shank and twist to correct. Then repeat the steps to be certain, raising it to check that it was well centered, then lowering and checking again.

Voicing procedures

String leveling

I believe that use of a string level is the most efficient way to establish a basis for mating hammers to strings. With practice and finesse, a piano's strings can usually be leveled very precisely within an hour or so. This saves a tremendous amount of time over "custom mating" practices, where bits of hammer crown are sanded. If the strings are level, and the hammer crowns are already sanded straight across (and travel and square are good), next to no hammer mating will be needed, or at any rate it will be minimal and very subtle. (The most common model of string level is available from Mother Goose tools. A new design which works from below the strings, featured in the July, 2009 PTJ, will soon be available from Pianotek as I understand. There are several other possible designs. I present a couple of my own in the slide show.)

The principle to remember is that it is more important for the strings to be in a straight line with one another, than for the bubble to be precisely centered. It is best that the bubble be centered if possible (otherwise the hammer crown will need to be slightly angled), but a straight line is critical. When plucking the three strings very lightly (a piece

of music wire works well as a plucker), each should be muted precisely the same amount by the level. Otherwise, una corda mating will be different from rest position mating, and voicing will be uneven sounding in one or the other. The level should be very lightly stabilized with a finger or fingers while plucking, to ensure that it doesn't wobble side to side. Strings should be pulled up with as light an action as possible to get them level. It is possible to lower the level of strings only a very little bit. Raising a string too high can be difficult or impossible to remedy without replacing the string.

As should be obvious, the part of the string that needs to be level is the strike point, the point on the string that is struck by the hammer, so the level should be placed as close as possible to that spot – usually just in front of the dampers. When dampers are in the way, as often occurs in the mid treble section, it may be more efficient to remove them for leveling, and this is a good opportunity for checking hammer alignment and letoff as well.

Deep shoulder needling

Hard-pressed hammers need considerable deep needling in the shoulders to obtain good tone quality. Generally this can mean something on the order of 40 or more strokes per shoulder with a three needle voicing tool. The technique used to insert the needles has a profound effect on the results, and on the longevity of the hammer. Rapid jabbing with the voicing tool will tear fibers more than spread them, which results in less tension within the hammer felt (as there are less connections between fibers), and also leads to more rapid disintegration of the hammer.

I strongly recommend developing a technique of pressing the needles into the felt: the needle points are held at the surface of the hammer and squeezed in, rather than jabbed from a distance, with the needles in rapid motion before they touch the felt. This takes somewhat longer (though with practice, it can be done fairly rapidly), but has many benefits: it gives far more control of exactly where the needles are inserted; it allows you to feel the felt with much more precision, to get a sense of how much needling will be needed and where in the hammer; and it spreads the fibers more than it tears them, resulting in more hammer integrity and longer life. When needles are moving before they strike the felt, they cause the felt to compress and compact before they penetrate, leading to more tearing of fibers.

Some hammers are so dense that a three-needle tool can hardly be made to penetrate. In these cases, a good first option is to remove one needle and do pre-voicing using two needles. This can often be done fairly rapidly, making two rows of two needle insertions, one along each edge of the hammer. Ten insertions per row are usually enough to allow for standard three-needle voicing afterwards. If the hammers are too dense for this, "voice grip" techniques can be used, squeezing and manipulating the felt with pliers of some sort to help loosen the felting.

Another possibility is the use of a formula of alcohol and fabric softener in the shoulders. I have used a formula of about 4:1 to 6:1 alcohol to unscented softener with good effect. It allows the needles to penetrate by removing the electrostatic charge from the fibers, meaning that very rapid and deep needling becomes possible where it had been difficult to get more than shallow penetration. This is experimental, and I don't have long term experience to draw on yet (three years so far, with no negative results yet), but it is

promising enough that I pass along the suggestion. I have used it successfully on Baldwin Hamilton, Abel, Yamaha, Sohmer, and Imadegawa hammers thus far. I am using 91% isopropyl as a rule, and applying the formula so that it penetrates only in the shoulder area, and does not wick into the strike point area. Sometimes the felt swells enough in this area that it needs extra filing, but the tonal results are positive where I had been unable to make much progress previously. Most of the swelling is due to the needling, not to the moisture.

For hard high treble hammers, very small needles – size 10 to 12 – can be used in the upper shoulders, for pre-voicing and/or final voicing. I find that about 3 mm of needle, in a five needle tool with a gap about 1 – 1.5 mm between needles works well. I insert it perpendicularly to the crown, and make 8 to 10 insertions evenly spaced from one edge to the other, just below the striking point. Needles this small should be inserted with care, precisely perpendicularly, so as not to break them. "Rolling" needling tools is never a good idea, but leads to disaster with these small sizes. The small diameter allows the needles to penetrate between all but the most tightly packed fibers.

Crown needling – una corda

Marking the hammers

Hammer crowns should be marked for string placement prior to doing una corda voicing, because precise placement of needles is essential. If the hammers are worn enough that small string grooves are present, there is no need to mark. When grooves aren't present, or when hammers are re-aligned to the strings, the crowns should be marked using carbon paper between the hammer and the string. The paper may be inserted with the action in place, fallboard removed, by using a manila folder to support the paper, and drape it over a section of hammers. The paper may be moved up or down the scale (while playing the keys to mark the hammers), using the manila folder to assist in sliding it.

Needling

Steinway teaches una corda needling using a tool with five or six #6 needles jammed together in a slot in a dowel, and glued in place. I find this tool far too coarse. I have experimented with smaller needles, set at different spacings, and find that I prefer to use #8, #10, and #12 for crown work. The needles are spaced evenly 5 needles per 6 to 8 mm, with about 2.5 – 3.5 mm of needle protruding. This provides a precision tool that can be used for very accurate and subtle work.

The smaller needles (#10 or #12) are used just to the left/bass side of the marked string grooves, and inserted at an angle slightly away from the mark. Usually, three stabs are used: one centered, and one to either side of the crown. The tool is inserted straight, not rolled (the #12 needles may break if a rolling motion is used, but will hold up quite well to straight insertion).

This is followed by insertion of a larger needle (#8 to #10) tool, at the point of furthest shift, very near the treble side of the two left strings. Again, this is done at a

slight angle away from the string mark. And the needles are inserted somewhat more deeply.

Doing this systematically gives a very nice gradation of piano tone through the shift pedal, with a lesser difference of tone in half pedal, and a maximum difference at full. (It is necessary to adjust the shift stop position precisely).

The #12, and sometimes the #10 needle tools can be used for maintenance voicing of the hammer in the rest position (tre corde). A piano that has become somewhat too bright can be brought down evenly and subtly using the small needles right in the string grooves. Experiment with how deep to insert, and whether to go in vertically only, or with stiches down either side as well. With this technique, a piano can be "brought down" in a matter of a few minutes, in a controlled and measured way. Use of these narrow diameter needles means that the fibers are less torn than they would be with #6 needles, so this also has the effect of prolonging the useful life of the hammers.

These techniques work with "hard-pressed" as well as lacquered hammers.

Mating

Fine mating of hammers to strings is absolutely necessary to achieve a fine voicing job. The hammer can be lifted to the string by pushing up on the jack tender, by pulling the shank up with a "hook", or by laying a strip of thin cloth between the repetition levers and the knuckles. I prefer using the jack tender myself, but the essential element is a very sensitive touch. The hammer should just barely touch the strings with no pressure. Plucking of the strings is best done with something light like a piece of music wire rather than the finger nail or a sharpened hammershank. The hammer should be pressed lightly against the strings for a pluck, then backed off enough so that all the strings "just" bleed. If all three strings bleed exactly the same, the hammer is well mated. It is very easy to press the hammer just a little harder into the strings and cover up inexact mating.

Correction of mating problems is a puzzle to be solved. Are the strings really precisely level? (It may be quickest to check with a string level). How level is the top of the hammer? (After filing hammers, the crowns should be very carefully examined for an absolutely straight line, best with a straight edge). If the hammer is to be adjusted, the best tool is the one developed by Andre Oorebek and sold by Pianoforte Supply, a piece of clear plastic with a narrow strip of sandpaper glued in its middle. This allows for very precise sanding of minute amounts of felt – which is all that should be required.

Note that not all unisons can be made level, for one reason or another, and sometimes hammers need to be custom sculpted to match. This is particularly common at breaks in the capo sections, where there may be a curve in the capo machining. And sometimes agraffes are drilled unevenly. Problems may also be caused by over vigorous string leveling work, where one or more strings have been given a bend more acute than the others can achieve.

Mating needs to be done while voicing, but should always be done as the very last step of voicing, as any needling or hammer filing may have an effect. Hammers that are even slightly badly mated will have a characteristic sound that will show up as unevenness, zinging noises at particular volumes or during rapid repetitions, and a generally unfocused and chaotic sound.