

Mason & Hamlin Factory Grand Regulation Procedures for Technicians

Regulating Specifications

Keyboard

Key Height - Front (Keybed to bottom of lip)	2-19/32", 65.9mm
Key Height – Back (Keybed to underside of key at lift felt)	
Models A-5, AA-64 and BB-1	15/16", 23.8
Models B-54 and CC-94	1", 25.4mm
Sharp Key Height (Measured at the peak of the tapered sharp)	1 / 2", 12.7mm (above white keys)
Keydip	25/64" (.390), 9.91mm
Aftertouch	.040 ", 1mm
Sharp Dip	Same after touch as whites

Action Setup

Shank Center Height	5.75", 146.05mm
Rep Center Height	
Down from Shank Center	2.5", 63.5mm
Up from keybed	3.25, 82.55
Spread	4-13/32", 111.9mm

Regulating Dimensions

Back Check Height (Measured at point of let-off)	1/16", 1.6mm below hammer tail
Hammer Blow Distance	1-3/4", 44.5mm
Let-Off (From String)	1/16", 1.6mm
Drop (From string with key at full depression)	1/8", 3.2mm
Checking (From String)	
Wooden back checks	1/2", 12.7mm
Composite Back Checks	7/16", 11.1mm

Misc.

Damper lift	1 / 2 stroke of hammer
Damper Up Stop Rail (Measure clearance on sharps at full depression)	1/16" to 1/8", 1.6mm to 3.2mm
Shift (Trichords)	Shift off left string
Shift (Bass)	Shift to softer felt

Regulating Procedure

Key and Action Prep

Certain things need to be done or at least eliminated before regulation can begin. Some of these things pertain only to new pianos, others are relevant mostly to pianos that have been in the field and played for some time. All are necessary.

- **Pedal Lyre.**

- Make sure the pedal lyre is mounted on the bottom of the keybed.
- The Mason & Hamlin pedal lyre is mounted using 2-1/2" long 1/2 x 20 hex head bolts with washers.
- The lyre support rods are adjustable so, if needed they can be installed after the lyre is securely bolted into place.
 - Lyre rods should be adjusted so there is no slack between the rod and the lyre to ensure support when the pedals are operated.

- **Action Compartment.**

- Make sure the action and action compartment is clean and free from the various kinds of debris that can accumulate in the action compartment.
- If compressed air is available then blow out the action and action compartment. If the plate and soundboard are covered with dust this is also a good time to blow out the rest of the piano.
- If compressed air is not available then use a vacuum and a soft brush. If you are cleaning the plate a soft paint brush (never used) in combination with the vacuum will get the dust from hard to reach places.

- **Action Screws.**

- Check the tightness of action screws.
- If the action is a composite action no tightening should be needed.
- If the action is an older wooden action then gently tighten the action screws as needed.
 - Do not over tighten as it is possible to ruin the flanges requiring replacement.

- **Lubricate.**

- Lubricate the keybed, keyframe, keyframe end blocks and the return spring.
- Use McLube Mac 444A.
 - Do not use the older McLube 1725L as the manufacturer has changed the formulation and the lubricant will become gummy with age.
 - Spray the keybed where the front rail, back rail and glide bolts contact the keybed.
 - Spray the both end blocks on the keyframe as well as and the front rail, back rail and glide bolts.
 - Spray the spring in the treble as well as the shift lever.

- **Traveling.**

Note: On the bass and tenor hammers there is an angle side to side that allows the hammers to clear each other as they travel to the strings. If, in an excess of zeal, you remove this angle you will cause the hammers to rub on one another. It is very possible this action could require the action to be reset side to side. This is a can of worms you do not wish to open.

When travelling and burning only correct the hammers that are not like their neighbors or are, in fact, rubbing one of their neighbors. If you think the setup incorrect check with the factory before modifying it.

- Travel using a thin rod or dowel.
 - Lift the hammer shanks and look for side to side movement in the hammers.
 - To check for loose pinning (relevant only for wooden shanks with cloth bushing) move the rod side to side to see if any of the hammers move side to side. Here a dowel with a bit of raised grain works better than a metal rod because the added friction between the rod and the shank better reveals loose pinning.
 - Correct travel by loosening the flange screw, place a paper shim under the flange on the side the hammer is traveling towards, center the hammer between adjacent hammers and re-tighten the screw.
 - Repeat until all travelers have been corrected.
- “Burn the hammers” as needed.
 - Visually inspect the hammers to ensure that all hammers are parallel to their neighbors.
 - The technique to correct tilted hammers is the same on both the wooden and composite actions.
 - Heat the shank using a heat gun.
 - Heat most of the length of the shank rather than a small area.
 - On a wooden shank this will keep you from overheating part of the shank and causing an unsightly burn mark in the wood. Likely you have also damaged the wood in this spot.
 - If you actually burn the shank you should replace it.
 - On a composite shank spreading the twist in the shank over a larger area preserves the structural integrity of the shank.
 - Do not put sideways pressure on the shank until the heat causes the shank to become flexible.
 - This is particularly important with composite shanks as it is possible to ruin the shank with sideways pressure before the shank becomes pliable.
 - On a wooden shank you are putting pressure on the cloth bushings which is also not good as it can change the pinning.
- Note: Any changes in traveling or shank burning will necessitate corresponding changes in the spacing of the hammers to the strings.

- **Key Easing.**

Note: Key easing ensures that the keys have the proper freedom of movement while the key is constrained to reduce noise and ensure that regulating dimensions are stable.

- Place the action on the regulating bench.
 - Remove the action from the keyframe.
 - Remove the keys from the keyframe.
- Remove debris from the keyframe with compressed air or a vacuum.
- Lubricate the key pins by spraying the keypins and key bottoms with McLube 444A.
- Check the freedom of movement of the key.
- There are three basic things that you need to evaluate and, if necessary, correct in key easing.
 - **The balance hole (1).**
 - Inspect the thickness of material in the balance hole.
 - This should be about 3mm or 1/8" in a key with hardwood in the bottom of the key as found in all Mason & Hamlin pianos.
 - If the material is more than 3mm or 1/8" this will cause binding on the keypin as the key moves through its motion.
 - Too little rarely happens.
 - However, if there is too little material and the hole is even slightly loose on the pin, it will wallow out and become excessively loose prematurely.
 - Isolate the balance hole by raising the key so that only the top of the balance pin is in the balance hole.
 - This removes the effect of friction in the front and balance rail bushings while evaluating the balance hole.
 - Try to move the key front to back and side to side on the balance hole.
 - The balance hole must never have discernable front to back or side to side movement between the key and the balance pin.
 - Try to raise and lower the key on the balance pin.
 - The key should fall slowly on its own.
 - Too fast is bad because there is too much clearance and is likely noisy.
 - If the key falls too slow or not at all this implies the hole is excessively tight on the pin which will cause playability problems.
 - Move the key as if it were being played on the balance pin.
 - The key should move through its range of motion without binding on the balance pin.
 - If the key passes all of the above tests you need do nothing.
 - If not, the balance hole needs to be corrected.
 - If there is too much material in the bottom of the key.
 - There is a tool that will correct this.
 - The tool is mounted on a handle with a thin shaft holding a cutter of about 8mm or 5/16" centered

- on the shaft around a pin slightly smaller than the balance hole.
 - The pin sticks out from the cutting edges by about 3mm or 1/8".
 - Place the tool into the mortice through the balance button and rotate the cutter against the bottom of the mortice in the key.
 - When the pin is flush with the bottom of the key the thickness of the material is correct.
- If there is too little material in the bottom of the key.
 - This is a difficult repair and would be best done when the key becomes excessively loose.
- If there is movement front to back or side to side between the key and the balance hole.
 - If the looseness is minimal and mainly front to back you can glue size the hole.
 - Dilute a glue such as Titebond or Hot Hide glue with water.
 - Swab the inside of the balance hole and allow to the glue to dry.
 - The water should swell the wood around the hole and the glue should stabilize the wood in the swollen state thus making the balance hole smaller.
 - Lube the bottom of the hole with Mac 444A.
 - Touchup the easing.
 - If the hole is very loose you will need to shim one side of the hole or the other with veneer.
 - Determine which side of the balance hole best positions the key front to back by moving the key front to back on the pin.
 - You will shim the other side.
 - If neither side of the hole works you will need to shim both sides of the hole.
 - To Shim.
 - Use a dovetail saw to cut a slot opposite the side that positioned the key properly.
 - Glue a piece of maple veneer into the slot using Titebond glue.
 - Sand the veneer flush to the bottom of the key.
 - Ease the balance hole as required when the glue is thoroughly dry.
- If the key is too tight in the hole you need to ease the balance hole in the key.
 - Start by swabbing the balance hole with McLube 444A. Often this will be sufficient to make the balance rail hole

work properly.

- If McLube 444A does not work then ease the key using the tapered easing tool.
 - Insert the tool through the button.
 - Rotate 90° so the working taper is pressing only on the sides of the hole and never front to back.
 - Press the tool down into the hole to compress the wood on the sides of the balance hole.
 - Be very careful as this procedure can cause great harm if improperly executed.
 - You can rotate the tool front to back at the same time and sometimes you must.
 - If absolutely necessary, you can ease front to back in the hole. Use great caution here as you can cost yourself a great deal of work if you are not careful.

▪ **The balance button bushings (2).**

- The balance bushing can be too tight, too loose or correct.
 - If correct then do nothing.
- Check the balance rail bushing for tightness by raising the key off the front rail and lowering the balance rail bushing onto the balance rail pin.
 - The bushing should slide smoothly onto the pin with no undue side to side motion.
 - Ease using key easing pliers.
 - Squeeze judiciously to compress the wood under the bushing.
 - You can make your key squaring easier by squeezing on the side of the key that is low before squaring during the level operation.
- Check the balance rail bushing for looseness by gently pressing on the button left and right to see the amount of movement in the bushing.
 - There should be approximately 1/64" or .4mm movement in the bushing.
 - More than this is too much.
 - If the balance bushing is only a small amount too loose you can gently tighten the bushing by using a flat jawed vice and squeezing the entire button just above the key.
 - If the looseness is excessive then you will need to rebush and perhaps shim with veneer as well.
 - Again, you can make your key squaring easier or harder depending on your choices here.

• **The front bushings (3).**

- Check the front bushings by putting your thumb on the front of the key and moving gently side to side.
 - There should be approximately 1/64" side play in the keys.
 - Sometimes the front rail pin is tapered.
 - If so check the side to side movement at the bottom of the travel.
 - If the key is too tight, ease using key easing pliers.

- Squeeze judiciously to compress the wood under the bushing.
 - You can make your key spacing easier by squeezing on the side of the key that the smaller gap exists between the key and its neighbor.
 - If the key is loose, you will need to re-bush and perhaps shim the mortice in order to get the proper key guidance from the bushings.
- Check key movement with the action on the keys.
 - Place the action on the keyframe and the keyframe in the piano.
 - Check the freedom of movement of the key.
 - Strike the key a sharp blow.
 - The key should rapidly rebound and bounce back and forth if it is sufficiently free in its movement.
 - Repeat above procedures if key movement is not sufficiently free.
- **Set final action position (Front to Back).**
 - Position the key and action assembly correctly front to back.
 - The easiest way is to use the key blocks to locate the action.
 - Check the action position side to side.
 - This should never need to be changed.
 - It is wise to look however as many things rest on this setting.
 - If you fail to see and correct a problem here much of the work you do on subsequent operations becomes invalid.
 - Check the relationship between the hammers, strings and whippen cushions.
 - Make sure that the hammershanks fall reasonably on the cushions.
 - Make sure that the error between the bass and treble sections is evenly distributed.
 - If necessary, move the action as required.
 - If you move the action you may need to:
 - Fit new keyblocks.
 - Fit a new insert in the keyframe.
 - Fit a new stop block.
 - Re-position the damper action.
 - Re-do the damper job.
 - At this point it is a major project to significantly move the action.
 - Do not undertake it lightly.
 - Find the correct location for the action front to back in the treble.
 - Lightly mark the keybed with the current action position front to back.
 - Check for sound at note 88.
 - Play note 88.
 - Move the action in or out to move the strike point on the string until a good musical sound is achieved.
 - There are two places where a musical sound can be achieved.
 - One is right next to the V-bar.
 - One is a little further out on the string.

- The correct spot for the hammer is the spot closest to the V-bar.
- Move the action forward and back to find the place where #88 sounds the best.
- Mark the location on the keyframe and keybed where the action is correctly located.
- Measure the distance from the front of the key just under the lip of note 1 to the keyblock.
 - The dimension should be 7/64" (2.8mm).
 - Check the margin between the white keys and the keyslip.
 - If the margin is inadequate to prevent rubbing between the white keys and the keyslip then you will need to move the treble keyblock or rehang the treble hammers which ever seems the easiest to you.
- Mark the keybed with the correct location.
- Find the correct location for the action front to back in the bass.
 - Measure the distance from the front of the key just under the lip of note 1 to the keyblock.
 - This dimension should be 7/64" (2.8mm).
 - This gives sufficient margin between the white keys and the keyslip.
 - If the margin is insufficient you will need to move the keyframe until the relationship with the bass keyblock is sensible.
 - Mark the keyframe and keybed so you can get the keyboard back to the correct location.
 - If the keyblock plates need adjustment we will do this after the keyframe bedding is checked.

● **Bed the keyframe.**

- Note: It is important to ensure that the bedding of the keyframe is solid and correct before you start a key level. You can not do level and dip on a badly bedded keyframe much less regulate. If you have one ounce of conscience you will have to do the job over at your own expense if you try to do level and dip on a poorly bedded keyframe.
- Check bedding of balance rail (glide bolts).
 - Push down on glide bolts with hand.
 - If the glides are high the keys will drop in front.
 - If using the WNG Keyframe Bedding Tool you will see the needle move.
 - If bedded the needle will move a small amount.
 - If not bedded, the needle will move a much larger amount.
 - Check to see if the glides are lifting the front rail off the keybed.
 - If the front rail is off the keybed or seriously knocking it suggests the balance rail is being lifted off the keybed by the glide bolts.
 - Check by lowering the glide bolt.
 - If the front rail drops you will have to re adjust the glide bolts.
 - If there is no change put the glide bolt back where it was.
- Check bedding of front rail.
 - Use your hand or a felted knocker and pound on the front rail.

- There should be no knocks anywhere on the front rail.
 - If there are knocks at the ends near the keyblocks you should hold down the keyframe and try again as this may only indicate incorrectly adjusted keyblock plates.
- Check the bedding of the back rail.
 - To check the bedding of the back rail you need a tool to do so.
 - You can use a long screwdriver (18", 457mm shaft) where the driver matches the screws in the action.
 - You can make a tool by gluing 1/4" (6mm) dowel into a larger handle and felting the end of the 1/4" dowel.
 - Either tool will work and essentially does the same thing.
 - Use the tool to reach down through the strings so that you place the end of the tool on the action screw fastening the action the action cleat.
 - Tap with your hand on the handle of the tool.
 - If the back rail knocks it needs fitting.
 - The knock may come from a poorly fitted back rail or it may indicate the action is lifting the back rail.
 - To diagnose this loosen the action screw and test again. If the knock disappears than the problem is the action is lifting the back rail.
 - If the knock persists, the problem is in the back rail.
- If all three rails pass muster then you do not need to re-bed the keyframe.
 - If you do so you are only making more work for yourself.
 - If any of the three rails flunk then you must re-bed the keyframe.
- If you conclude the keyframe must be re-bedded:
 - Remove the action and keys from the keyframe.
 - Position the keyframe in the action compartment using the marks you made earlier.
 - Turn the glide bolts up out of the way.
 - These will be fit last.
 - Bed the back rail.
 - Use your hand or a felted keyframe knocker to find knocks in the back rail.
 - Use strips of 220 grit sand paper to sand areas that do not knock so that the areas that do knock come into contact with the keybed.
 - One trick to make this easier is to tape the back of the sandpaper with masking tape or even duct tape.
 - Also, use C grade paper as it is thicker and less prone to tearing than A grade paper.
 - Using belt sander belts with a cloth backing will resist tearing the best.
 - Continue to fit the back rail until all knocks are removed.
 - Attach the top action.
 - Test the bedding as before.
 - If the back rail now knocks you need to place a shim either between the action foot and the cleat or between the action bracket and the repetition rail.
 - If the action rails are soldered into the action brackets.
 - Your only choice will be to shim the action cleat to solve this problem.

- Usually maple veneer glued to the cleat is a good solution.
 - This will typically require sanding to achieve an exact fit.
 - If the action has a removable rail.
 - If the gap to be filed is considerable then use veneer and fit as above.
 - If the gap is minimal then use front rail punchings between the repetition rail and the action bracket in question.
 - Trim the punchings after installation for a neat job.
 - Continue this process until the back rail, with the action attached, no longer knocks on the keybed.
- Bed the front rail.
 - Remove the top action from the frame.
 - Use your hand or a felted keyframe knocker to fine areas that knock in the front rail.
 - Strike the keyframe on the edge of the front rail going across the keyboard.
 - Hold the ends down as they should be 1/32" to 1/16" up in the air.
 - If the ends are hard to pull down likely the planing of the front rail is wrong.
 - Correct the bedding for the front rail as indicated.
 - Use sandpaper strips (220 grit paper) to correct small areas that knock.
 - Sand the areas where the front does not knock which will bring the areas that do knock into contact with the keybed.
 - Continue this process until the front rail is bedded.
- Bed the glide bolts.
 - There are two basic methods to bed the glide bolts.
 - To do the traditional "slide the paper" method.
 - This method creates a very small gap between the glide bolt and the keybed when all the keys are removed however, when the keys are added, the additional weight causes the glides to rest firmly on the keybed dowels. Two things to consider. First, this only works if the slats in the keyframe are relatively flexible. Second, this has the added benefit of putting a small amount of pressure on both the front and back rail.
 - Remove the keys from the keyframe.
 - Attach the top action.
 - Position the keyframe and action correctly to the marks established earlier.
 - Make sure there is gap between all the glides and the keybed.
 - Use a piece of paper cut 2" by 12" long and approximately .004 thick.
 - Newspaper works well.
 - Start in the middle of the keyboard and work towards both ends.
 - Keep checking the ones you have already adjusted to be sure you have not lifted them off the keybed.

- Slide the paper under the glide and adjust until the paper just drags between the keyframe and the keybed.
 - When the paper is out there should be just the slightest knock between the glide bolt and the keybed.
 - Later, when the weight of the keys is on the keyframe this knock will disappear.
 - At the ends of the keyframe you will need to hold the front rail down to the keybed as this affects the glide bedding.
 - Also, at the ends of the keyframe, friction from the stop block or the spring can hold a keyframe up in the air.
 - Bounce the keyframe back and forth on the shift pedal in the treble to overcome friction to the shift spring.
 - Hold the keyframe off the stop block in the bass while checking the glide bolts.
- To use the WNG Keyframe Bedding Tool method.
 - Remove all keys except three keys near each break and at both ends.
 - Attach the top action.
 - Position the keyframe and action correctly to the marks established earlier.
 - Make sure there is gap between all the glides and the keybed.
 - Place the keyframe bedding tool on the keys nearest to the center of the keyboard.
 - Make sure the plunger for the dial indicator is against the pinblock.
 - If required you can adjust the location of the dial indicator until this happens.
 - Zero the needle by turning the outside zero indicator to match the needle.
 - Adjust the center glide until the needle starts to move.
 - The weight of the tool will cause the needle to move so you will need to make an adjustment and then remove the tool.
 - You are trying to adjust the glide until it is in contact with the keybed while not lifting the balance rail at all.
 - Adjust the next glides out on each side and then recheck the center glide.
 - At the ends of the keyframe there are two issues.
 - You will need to hold the front rail down to the keybed because if you do not the glide will be adjusted too far down and will hold the front rail up from the keybed which is not desirable.
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 - Also, at the ends of the keyframe, friction from the stop block or the spring can hold a keyframe up in the air.
 - Bounce the keyframe back and forth on the shift pedal in the treble to overcome friction to the shift spring.
 - Hold the keyframe off the stop block in the bass while checking the glide bolts.

- Continue until all glides are adjusted.
- All three rails must be properly bedded after this procedure is done.
 - If not – do again until this is true.
 - Do not proceed further with action regulation until the keyframe is correctly bedded to the keybed.
 - **Any regulations done on an incorrectly bedded keyframe are invalid and the time spent will be wasted.**
- **Adjust the keyblocks.**
 - Adjust the location of the keyblock plate until the guide holds the action in the desired location.
 - This was established earlier.
 - Screw down the adjusting screw until the plastic guide contacts the key frame guide pin.
 - Lift on the keyframe while holding down the keyblock.
 - You should not be able to lift the key frame however the keyblock should not rock on the key frame guide pins.
 - Make sure that the keyboard shifts back and forth smoothly.
 - Make sure that when the keyblock is adjusted and tightened down that the pressure is not sufficient to lift the keyframe in some other place on the front rail.
 - The pressure on the guide pin can cause the end of the rail to act as a fulcrum causing the rail to lift in a ways from the end.
 - Check the key clearance to the keyblocks and keyslip.
 - If the keys are too close to the keyslip in the treble when the keyboard is located properly for good sound at note 88 then you must re-hang the treble hammers to correct this.
 - In the bass it is sensible to move the keyframe in or out to achieve clearance between the fronts of the keys and the keyslip.
- **Key level, key dip & space.**
 - Setup level stick to the correct height.
 - Adjust the end white keys to the correct height.
 - If the end white key height is within +/- 1/32" (.75mm) of spec and essentially the same on both ends, it is not necessary to change the key height as there is little benefit.
 - White key height is 2-19/32 to the bottom of the lip.
 - Sharp key height is 1/2" above the white keys at the highest point.
 - Square keys.
 - Use a key level stick to check for square keys.
 - Bend the balance rail pin from side to side until the white keys are square.
 - Do not use a metal tool to bend the balance rail pins.
 - Use a wooden tool that will not damage the balance rail pin.
 - Check the sharps.
 - If required bend the balance rail pin as on the whites to correct sharp squaring.
 - Go over key level.
 - If the key level is close to correct you can use cut punchings.

- Slit the punchings so that they can be put onto the balance rail pin from the bottom without removing the top action.
 - You should only use this technique on a small number of .005 or smaller balance rail punchings.
- If the key level is dramatically off then take off the action stack and level using clip on leads in the piano.
- Recheck after the action stack is replaced and touch up using cut punchings.
- Go over the sharp level.
 - Use punchings as with the white keys.
 - Square sharps with a level stick as on the whites.
 - Level using the Jaras sharp level tool.
 - Level as with the white keys.
- Check key spacing and space as necessary.
 - The spaces between the keys should be uniform.
 - There should be no wide or narrow spaces.
 - Space by bending the front rail pin.
 - Usually you bend several notes each side of a wide space to spread the correction over a number of notes.
 - Be careful to avoid putting burrs on the front rail pins.
 - One way to avoid this is to use a tapered front rail pin bender that is used under the front rail punchings.

Note: The key dip we are setting here will be adjusted for after touch after the regulation is complete however, to have a valid regulation you will need to be accurate anyway.

In order to do an accurate regulation, you need to set the initial keydip very accurately to whatever dimension you wish to use. US supply houses provide paper front rail punchings down to .003" or .076mm. European supply houses can provide paper front rail punchings down to .002", .05mm.

It is in your self-interest to do keydip as precisely as possible. The WNG weighted keydip block makes this easy and quick and was the very reason this tool was developed.

- Set white keydip.
 - Use the WNG Weighted Key Dip Block with the float pin set to 25/64" (.390 or 10 mm) keydip.
 - Put the punchings on the cloth front rail punching and go to the next note.
- Set sharp dip;
 - Setup trials for sharp dip.
 - Regulate the white key C-40 and the sharp C#-41.
 - Make sure that the regulation is as close to perfect as possible.
 - Set the dip on the C#-41 so that the after touch is the same as on C-40.
 - Measure the after touch by putting a .040 punching on both the white and the sharp
 - Raise the hammer line until there is no after touch and let off is achieved with only the slightest compression of the front rail punching.
 - Do the same on both notes.

- Depress the sharp with the weighted key block and set the Jaras Tool to read the dip on that note.
- Set sharp dip on the rest of the sharps.
- Put the punchings on the cloth front rail punching and go to the next note.
- Turn over the punching for both the white and black keys so that the felt is on top of the paper punchings.

• **Space hammers to strings.**

- Put the action in the piano and space the hammers to the strings.
 - Space treble hammers.
 - Place a 1/32" (.75mm) shim between the bass stop block and the action.
 - Space the hammers so that the edge of the hammer is on the edge of the string.
 - This will give you a very consistent spacing of the hammers to the strings and will make adjusting the shift much easier.
 - Remove the 1/32" (.75mm) shim from the stop block.
 - Space bichord hammers.
 - Space the bichord hammers so that there is 1/32" (.75mm) clearance to the treble side of the strings.
 - Check on the shift to make sure the hammer does not shift off the bass side of the string.
 - Space unichord hammers
 - Space the bichord hammers so that there is 1/32" (.75mm) clearance to the treble side of the strings.
 - Check on the shift to make sure the hammer does not shift off the bass side of the string.
 - Re set the action to the bass or the treble if hammers are in danger of falling off the rest cushions.
 - If you do this you will also have to shim or remove material from the shift slot to preserve the relationship between the shift lever and the action.

▪ **Travel & space repetitions.**

- Space the repetitions to the knuckles.
 - Tilt & Swing.
 - Tilt is achieved by rotating the repetition under the knuckle.
 - Swing is achieved by papering one side or the other of the flange causing the jack to move sideways.
 - In general, the repetition should be close to perpendicular to the repetition rail.
 - On a tubular action.
 - Tilt is achieved by rotating the repetition on the screw and tightening the screw.
 - There are limits on how far this can go.
 - Swing is achieved by papering one side or the other of the repetition flange.
 - Tilt the repetitions from side to side until the repetition is centered under the knuckle.
 - Swing the repetition as needed to achieve this.

- Check to make sure that the repetition is also centered on the capstan.
 - Modify both tilt and swing as needed to achieve this.
 - Make sure that the jack hits firmly on the regulating button.
 - Modify both tilt and swing as needed to achieve this.
 - Some combination of swing and tilt will yield the best combination of centered under the knuckle, centered over the capstan and the jack tender hitting the regulating button.
 - On a traditional WNG or new composite WNG action.
 - Swing is achieved by papering one side or the other of the flanges.
 - Tilt is achieved by papering the bottom of the flanges.
 - Start by tilting the repetition to center the balancier under the knuckle.
 - Swing the repetition while modifying the tilt to center the heel over the capstan.
 - Make sure the jack tender is firmly hitting the let-off regulating button.
 - Modify both tilt and swing as needed to achieve this.
- **Pre-set balancier height for a stable hammer line.**
 - Adjust the balancier height so that the jack is level with the balancier.
 - It is easy for an incorrectly regulated balancier to hold the knuckle away from the end of the jack creating lost motion.
 - This lost motion is quite problematic in the early stages of a regulation and can cause you to do several regulations over unnecessarily.
 - (This is not the final regulation. The purpose of this technique is only to assure you of a stable hammer line during the beginning stages of regulation.)
 - In particular this needs to be done prior to setting trials in the piano.
 - **Go over back check parallel bends.**
 - Regulate the back checks to center the tails on the back checks.
 - Bend the back check wires side to side in parallel bends so that the back check is centered under the hammer tail.
 - In the tenor with pianos that have hammer boring with a lot of angle you may have to cheat the check away from the adjacent hammer to keep the check from rubbing on the adjacent hammer.
 - Another technique on such pianos is to use a razor blade to create clearance by carving a bevel on the shoulder of the hammer.
 - Look from the front. It will not seem the same as it does from the back.
 - Check the rake on the back check
 - If the hammer slips through when lightly tapped with your finger this indicates insufficient rake.
 - Hammer bounces off the back check this indicates excessive rake and can be confirmed visually.
 - Rough regulate checking.
 - Bend the check so that the hammer checks in the normal checking area of the check.
 - Do not worry about the distance at this time. Just make all hammers catch without scuffing on the upstroke.

- **Setup action for bench regulation.**

Note: Getting the keydip on the bench the same as in the piano in combination with setting the trials as detailed below is the secret to getting a high quality bench regulation.

It is true that a high quality regulation can be achieved in the piano for most regulations however, regulating on the bench takes considerable less time.

The speed of a bench regulation, as long as it is accurate, will help you make a better living working on piano actions.

- Set trials.

Note: This method determine the actual location of the strings in relation to the action better than any other. Accuracy here is crucial because your entire regulation rests on these steps.

- Put action in piano.
- Set outside trials.
 - Set the first and last note of each section so that the hammer just brushes the string.
 - Done correctly this trial will tell you very accurately where the string really is.
 - Make sure that you do not block the hammer against the string and get a false reading.
 - If required to get sufficient aftertouch raise the hammer line to 1-5/8".
- Set inside trials.
 - Set the next note in from the ends so that the hammer blow distance is 1-3/4" from the string and let-off is 1/16".
 - This is done as a check on the outside trials.
 - If you have a discrepancy when you get to the regulating rack then put the action back in the piano and find out which one the error is occurring on.
- Do all sections of the piano in this manner.
- Setup key and action assembly for bench regulation.

Note: The goal is to set up the regulating rack so the rail that simulates the strings at the strike line of the piano is as close to their actual position as possible.

There are several kinds of regulating racks available. The Piano Supply Houses supply a version of such a tool. Also, Chris Brown has the Regulation Station or you could build your own rack.

The directions below are for the system we use at Mason & Hamlin as that is what we are used to. The other options you will need to consult the vendors for setup directions.

In any case, the goal is the same in all three cases, that is, simulate the location of the string plane as accurately as possible.

- Set up the regulating rack.

- It is a good idea to weight the supply house regulating rack otherwise it moves too much during regulation.
 - Any weight secured to the base will work however in a piano shop the easiest is a couple of boxes of tuning pins.
 - One might even salvage old tuning pins removed from a piano for this purpose as the weight required to stabilize a regulating rack doesn't really require shiny new tuning pins.
- Place key and action assembly on the regulating table.
 - Locate the action right to left so that the end notes of a section are on the regulating rack.
 - Locate the action front to back so that the hammers squarely strike the rack.
- Set height of rack on each section using the trial notes regulated.
 - Adjust the section rack up or down using the wing nuts.
 - Loosen the bottom wing nut to give plenty of slack.
 - Set the height using the top wing nut.
 - Adjust the height until the outside trials just brush the rack.
 - Check the blow distance on the inside trials.
 - They will never be perfect however if they are within 1/32" of each other proceed with the regulation.
 - Tighten the bottom wing nut to secure.
 - Re-check the trials.
- Set up the keyframe on the bench so that the keydip is the same on the bench as in the piano.

This is the second part of the equation. The keydip on the bench must be the same as the keydip in the piano. If it is not, regulations such as drop, checking and springs will not be accurate.

This is a method to control keydip on the bench.

- If you have not measured keydip in the piano do so now.
 - You must know the keydip in the piano in order to duplicate it on the bench.
- Use the weighted keyblock to measure the keydip on the bench.
 - If you used this tool to set keydip in the piano it is a simple matter to use the same tool setup in the same way to measure keydip on the bench
 - You should expect the, without intervention, the keydip on the bench will always differ from that in the piano as the bench is never the same as the keybed.
- If you are working with the traditional supply house regulating racks:
 - Shim the keyboard under the balance rail glide bolt or under the front rail to achieve the same keydip on the bench as in the piano.
 - Use front rail punchings on the front rail.
 - Use cardboard or veneer on the balance rail.
- If you are working with Chris Brown's Regulation Station you will need to consult with him for these operations.
 - Likely it is easier on the regulation station as these operations are designed into the tool itself and are central to its operation.

- Usually it is a good idea to not change the letoff and hammer line regulations on the samples until you are entirely through with that section.
 - This means do not change the trials until the cleanup is complete.
 - That way you will be able to see if the rack has changed during the regulation process.

Note: From here on the instructions are for each section. It is easiest and most efficient to regulate each section in its entirety and then move to the next.

● **Set hammerline.**

- Regulate a hammer line trial every 5th note.
 - Use a hammer line gauge to set to 1-3/4".
 - Currently all Mason & Hamlin grand pianos use a blow distance of 1-3/4" however, this could change in the future.
 - Check current specs to be sure.
 - Regulate the hammers between the samples by eye only using no gauge.
 - Bounce hammers from time to time to make sure that they are on the jacks.
- Turn the capstan to set the hammer line.

● **Regulate jack position.**

Note: Hammer line must be set correctly to regulate the jack position.

- From the side of the action hold the shank with your finger and depress the balancier to see the jack position.
- The jack should be regulated so that the back side of the jack lines up with the back side of the wooden center of the knuckle.

● **Regulate let off.**

Note: Let-off is independent of all other regulations in that a change here does not change other regulations. You do. However, need drop regulated below let-off and enough after touch to allow escapement. It is not impossible that you will need to raise the hammer line to regulate let-off.

- Regulate let-off to 1/16", 1.6mm below the regulating rack.
 - Regulate by turning the eye screw on the regulating rail.
 - Operate the key slowly so that you can see the high point of the hammer travel.
 - Regulate the let-off so that the high point is 1/16" away from the regulating rack.
 - You can use a gauge if you must but most people are able to gauge 1/16" by eye after they have been regulating grand actions for a while.

● **Regulate drop.**

Note: Drop is dependent on having enough key dip and after touch for drop to be regulated properly.

- Regulate drop to 1/8", 3.2mm below the regulating rack.

- Drop is measured with the key at full depression against the front rail punching.
 - If you try to measure anywhere else the measurement will not be reliable.
- Drop is regulated by turning the drop screw to raise or lower the hammer to the drop regulation.
- Use a drop gauge to set every 5th hammer to 1/8" drop.
- Regulate each note by raising drop to less than the spec and regulating down to the proper distance.
 - An accurate setting of drop requires the drop screw to be against the buckskin on the balancier. You can only be sure of this by regulating down.
- Regulate the hammers between the samples by eye only using no gauge.
- Hold down all 5 notes using even pressure on the keys.
- Use small screwdriver to turn the drop screw.
- If the spring tension is too low this regulation will not work properly.
 - If the spring tension is too low the balancier will not support the hammer weight.
 - If the balancier pinning is too loose you will have the same problem as if the spring tension is too low even if there is sufficient rise on the hammer.
 - To check the balancier pinning do the following:
 - Remove the spring from the jack and rotate the spring out of the way.
 - Get a 5-gram weight from gram weight set.
 - Place weight on the balancier in the drop buckskin area.
 - Re-pin the balancier if it will not support 5 grams in this fashion.
 - After re-pinning the balancier you must re-regulate the spring so that there is after throw (hammer rise).
- Sometimes, in the first 10 notes of the piano it is necessary to lower drop in order to achieve soft blow checking.
 - Usually, if drop is set 1/32", .75mm lower, that is all that is required to achieve soft blow checking in the lower bass.

• Regulate checking.

Note: Checking is dependent on keydip to be regulated properly.

- Use the gauge to set every 5th note to the proper checking distance.
 - On older Mason & Hamlin grand pianos the proper checking distance is 1/2", 12.7mm.
 - On newer Mason & Hamlin grand pianos with composite actions the proper checking distance is 7/16", 11.1mm.
 - The higher checking distance of 7/16" will get you much better soft blow checking and improved repetition. Also, the pianist will like this setting.
 - Bend the check forward or backward to achieve this regulation.
 - Continue to check rake.
 - If you installed checks with the WNG backcheck system likely you will not have to adjust rake.
 - If you feel you need to adjust rake place a backcheck bender on the wire halfway between the check and the backcheck block on the key.
 - To increase rake, place your index finger on the front of the backcheck and lift the bending tool without allowing the check to move forward.

- This creates both bends required to increase rake.
 - To decrease rake, place your thumb on the back of the backcheck and lower the bending tool without allowing the check to move backward.
 - This creates both bends required to decrease rake.
- Move the regulating rack back so that the hammers will clear the rack.
- Regulate the remaining 3 notes between the samples.
 - Play 5 notes at a time.
 - Bounce the hammers so they come into the check with considerable force.
 - Regulate the notes between the samples by eye by bending the backcheck forward or back.

● Regulate springs.

Note: To regulate springs precisely, key dip, hammer line and drop must be done properly. Drop is dependent on keydip to be regulated precisely however; the effect is not strong so springs can be roughed in early in the process without key dip being set properly.

- The hammer should have a smooth positive rise on the balancier.
 - It should be as fast as possible without bouncing.
 - The pianist should never feel the springs pushing the keys up against the fingers.
 - The hammers should rise faster in the treble than in the bass.
 - This is possible because the hammer weight is lighter and can be accomplished without any deleterious consequences.
 - It is desirable because the treble needs faster repetition.
- Bend the springs to achieve this end.
 - To reduce after throw:
 - Use the spring bending tool to push down on the spring under the balancier.
 - To slightly reduce after throw iron the bottom of the spring with the bending tool.
 - To increase after throw:
 - Place the spring bending tool next to the balancier support flange and bend the spring slightly against the bending tool.

● Regulate balancier height.

Note: balancier height is highly dependent on keydip as well as the spring regulation and balancier pinning to be regulated properly.

- Gently depress the jack tender while holding the key with your other hand.
- The hammer should just wink without unduly dropping.
- When you release the jack tender the jack should return beneath the knuckle.
- Turn the regulating screw at the back of the balancier until this works properly.
- Sometimes the spring tension will not let this regulation work properly.
 - If the spring tension is too low the jack will not return unless the balancier is too high causing lost motion between the jack and the knuckle at rest.
 - If the balancier pinning is too loose you will have the same problem as if the spring tension is too low even when the hammer rises to fast. It will also make it very difficult to regulate the drop.

- To check the balancier pinning do the following:
 - Remove the spring from the jack and rotate the spring out of the way.
 - Get a 5-gram weight from gram weight set.
 - Place weight on the balancier in the drop buckskin area.
 - Repin the balancier if it will not support 5 grams in this fashion.
 - Re-regulate the spring for proper afterthrow.

- **Clean up hammerline, drop, springs & check.**

Note: This is the last time through so this is your fine regulation.

- Check the regulating rack to be sure that the checking regulation did not knock it out of adjustment.
 - Use the trials you set in the piano to assure yourself that the rack has not changed.
 - If the rack has changed reset the rack to the correct height.
 - Also check to make sure that the key dip is still the same.
- Go over let-off.
 - Let-off should not have changed.
- Go over drop.
 - Drop should have changed somewhat from the various regulations that you have made.
 - Bring drop to 1/8" from the string.
- Go over springs.
 - There should be minimal changes in the springs but the balancier height regulation can potentially change the spring regulation.
- Go over checking.
 - Checking should be close but it likely will have changed somewhat.
 - Bring checking to 1/2".
- Do the above steps for all sections of the piano.

- **Regulate the trials.**

Note: Earlier we didn't regulate the trials because it allowed us to check if the regulating rack has changed. After all other aspects of the regulation are completed it is time to regulate the trials as they must be regulated the same as all the other notes.

- Clean up the regulation on the trials so they are regulated exactly the same as the rest of the notes in the piano.

- **Adjust key stop rail.**

- Adjust up or down until the sharps will lift only 1/16".
 - Make sure that no keys are depressed by the stop rail.
 - One way to test this is to tap the key stop rail with your fingers. If you see movement in the hammers the key stop rail is too close to the keys.
 - If necessary, loosen the nuts and raise the stop rail.

- **Touch up damper regulation.**

- Correct ringing dampers.

- Hit each note a sharp staccato blow and listen for after rings.
 - Fix all ringing dampers.
- Make sure that all underlevers are in at the same height.
 - Visually inspect to be sure that the underlevers are even across the entire piano.
 - To correct:
 - Place a 1-1/2" block under the wood part of the underlevers.
 - Loosen the screw of the offending underlever.
 - Make sure that the underlever is on the wooden rail.
 - While slightly depressing the damper with your hand tighten the screw on the underlever.
 - Make sure that the underlever is not being held up by the rail.
 - Twist the damper wire with a pair of pliers to seat the damper in the strings so that it lifts with no twisting or turning.
- Take all travelers out of the damper job.
 - Parallel bends regulate the motion of the dampers to one another.
 - Twist concerns the rotation of the damper around the damper wire and socket in the underlever top flange.
 - Hook regulates the side to side position of the damper over the strings.
 - To diagnose and correct parallel bends:
 - If the parallel bends are correct, after the dampers have cleared the strings they will move side to side and front to back like a block of wood.
 - If you have traveling dampers (inappropriate motion), do the following to correct.
 - Use the bending pliers.
 - Raise and lower the dampers on the sustain pedal with the dampers above the strings.
 - Watch the dampers for movement.
 - Touch up the parallel bends to remove the movement in the damper heads.
 - On any damper that you changed the parallel bends inspect the lean.
 - Make sure that the damper lightly leans against the bushed hole in the damper guide rail.
 - Make sure that the lean is not excessive.
 - The damper will appear sluggish if the lean is excessive.
 - Twist and hook must necessarily be worked together as the dampers contact the strings.
 - On the wedge strings.
 - If the strings appear to be rotating the damper as the wedges come into contact with the strings then:
 - Correct the twist as needed.
 - Use a pair of pliers to grab the damper wire and rotate the damper by forcibly rotating the damper wire in the under lever top flange.
 - If the damper is being pulled one way or another at both ends of the damper then add or remove hook until the side to side position of the damper is correct.
 - Use the damper hook to move the damper head in either direction so that the damper felt sits over the strings properly.

- If it is an unichord the string should be centered in the felt without pulling the damper head in either direction.
 - If it is a bichord the wedge should be centered between the strings without pulling the damper head in either direction.
 - If it is a trichord the wedges should be centered between the strings without pulling the damper head in either direction.
- On the flat dampers.
 - Regulate twist to align the damper with the strings.
 - Regulate hook to center the damper over the strings.
 - Use the tools and procedures as above.
- Make sure that all dampers are seated on the strings and raise front to back from the strings in a uniform manner.
 - Use your hand to tip the damper front to back while lifting just the very beginning of the pickup on the dampers to see uneven tilt on the dampers.
- In all likelihood you will need to repeat these steps several times as they interact with each other. Do not go on until the basic bending is complete.
 - If you have done extensive bending you will need to reset the underlever height and re-twist to re-align the dampers.
- Regulate the lift to the key.
 - Use the damper lift gauge.
 - On the bench adjust the gauge so that the bottom of the gauge rests on the key end felt.
 - In the piano regulate the ends of the section that you sampled in step 2.
 - Bend the spoon so that the gauge will just slide under the spoon.
 - Put the action in the piano and check the damper lift to the key.
 - The damper should lift at approximately 1/2 stroke of the key.
 - At Mason & Hamlin we use a gauge (3/4") to check this regulation.
 - Pull the action out and re-bend the spoon until the proper lift is achieved.
 - Regulate the section.
 - Repeat for each section.
- Regulate the upstop rail.
 - Adjust the upstop rail by loosening the screws, moving the rail up or down, and re-tightening the screws.
 - There should be 1/32" clearance between the underlever and the felt on the upstop rail when the sharp is fully depressed.
 - This will leave slightly more clearance on the white key.

• Regulate sostenuto.

- Make sure that all sostenuto tabs on the underlevers line up.
 - If the underlevers are not evenly aligned correct by re-setting the underlever.
 - If the underlevers are aligned, use cut balance rail punchings if necessary to achieve this.
- Adjust the sostenuto rod so that the tab is vertical prior to rotation and the bottom of the tab is approximately 1/16" above the tabs on the underlevers.
- Adjust the sostenuto rod in or out until notes played are caught and other notes still play normally.
- Adjust the sostenuto trapwork stop so that the sostenuto rod stops horizontal to the keybed when the pedal is completely depressed.

- Use slot screwdriver to adjust the adjustable stop to regulate the end condition of the sostenuto rod.

• Regulate sustain & shift pedals.

- Regulate the sustain pedal.
 - Regulate the pedal rod so that there is 1/5th of the pedal travel free until the dampers start to lift on the pedal.
 - Regulate the sustain stop screw so that the dampers just wink on a full blow by a white key and do not wink when played on a sharp key.
 - Use slot screwdriver to adjust the adjustable stop to regulate the amount of damper lift on the sustain pedal.
 - Make sure that the stop is controlling overall damper lift and not the upstop rail.
 - After the stop is adjusted you should still be able to lift the damper a very small amount into the upstop rail.
- Regulate the shift pedal.
 - On older Mason & Hamlin pianos:
 - Remove the treble keyblock from the piano.
 - Turn the stop screw in or out on the keyblock.
 - Return the treble keyblock to the piano and check the action travel.
 - Continue until the treble hammers just miss the left string when shifted.
 - On newer Mason & Hamlin pianos:
 - Turn the capstan on the treble key on the keyblock.
 - Check the action travel.
 - Continue until the treble hammers just miss the left string when shifted.
 - Block the shift lever.
 - Use a piece of firm red felt to block the shift lever directly above the pedal rod.
 - Cut the felt so that when the keyframe hits the stop screw the shift lever will hit the felt.
 - Glue into place with white glue.
 - This will give a much better feel on the shift lever.

• Close up piano and complete.

- Re-install action in piano.
- Install keyblocks and tighten into place.
 - Check shift to be sure that you are not pinching the keyframe with the keyblocks.
- Re-install the fallboard.
- Re-install the music desk.
- The piano should be ready to play.