USING THE ERWIN ACTION RATIO GUAGE—

The Erwin Action Ratio Gauge is a diagnostic tool that can help precisely determine the desired weight of new hammers in a grand piano action. It is one of several tools you can use to diagnose and optimize the touch and performance of a grand piano.

USING THE GAUGE --The Erwin action ration gauge will determine how far the hammers rise per unit of key movement. Simply place the gauge at the front of the key to be studied. The gauge will depress the key 6mm. The hammer rise is measured in millimeters from the top of a neighboring hammer to the top of the raised hammer. If the hammer rises 36mm, and the key is depressed 6mm, dividing the 36 by 6 gives us an action ratio (AR) of 6 -1.

6-1 action ratios are quite common in many old Steinways, Baldwins and Mason & Hamlins. These actions typically used light hammers. If heavier hammers are installed, each additional gram of hammer weight would equal six more grams of downweight. If you are happy with the action ratio, and with the touch weight of the action, then the shank/flange and current knuckle placement should be duplicated, and the hammer weight should be duplicated. It is important to measure the weight of several hammers currently on the action. An inexpensive electronic digital gram scale should be sufficient for these measurements. When changing hammer weights in a grand action, other options are available, such as changing knuckle distance, relocating capstans, etc. For a more detailed discussion of grand piano action ratio and action measurements see the following informational pages

Step 1. Measure the action ratio of all the 'C' and 'C#' notes

Step 2: Measure the down weight and up weight of all of the "C" and "C#" notes.

Step 3: Remove each of the "C" and "C#" hammers and record their weight.

Step 4: Determine whether you wish to make changes to the down weight and up weight.

Step 5: Using the action ratio, determine the desired weight of the new hammer.

Example:

1. The action ratio measures at 5.7 to 1.

2. The down weight is 58 grams. The up weight is 28

3. The existing hammer weighs 9 grams at note 4.

4. You decide that you want the down weight to be 54 grams and the up weight to be 24

5. For the desired 4 gram change, divide the 4 grams by the 5.7-1 action ratio

6. The new hammer must weigh .7 grams less than the old one

7. Subtract .7 grams from the original 9 gram hammer.

8. The new hammer needs to weigh 8.3 grams.

9. If a 9 gram hammer is desired then increasing you knuckle distance from the center pin 1 mm (.040) will decrease the action ratio by.4. The new ratio is 5.3.

10. A 2 mm change in the capstan placement will lower the ratio anothr.4

The Spurlock touch weights will only tell us the existing **down and up weight** of the keys at pianissimo levels. They tell us nothing about **inertia** but they are useful all the same.

Friction enters the equation here too and the sample keys from which down and up weight measurement are taken should be free of stiff center pinning or tight key bushings. Flattened knuckles also add to the friction. (Wippen assist springs complicate everything)

Observing key leading patterns is important. How many and where is critical information for getting to the desired goal.

Balance weight is also something important to consider. It is the down weight plus the up weight added together and divided by 2 that = the balance weight, i.e. If the down weight is 50 and up weight is 24, the two added together =74. Divided in half is a balance weight of 37. This is a balance weight that many pianists like. Concert grands can often handle as much as 40. 35 is usually a light feeling action. IMO anything over 40 needs attention.

Key leading often will be a typical 3,2,1 pattern from bass to treble.

Action regulation.

Other diagnostic tools to confirm AR are the regulation parameters themselves, i.e. Using sample keys to set an accurate key dip of 10 mm (.393) at the key pin. Set a hammer blow distance of 45 mm (1 ¾ inch). Set a 1.5 mm let off and 1mm drop. Depress the key slowly thru let off and observe the amount of, or lack of, after-touch. Shallow key dip and long hammer blow distances are sure confirmations of a very high action ratio. Usually this set up is over 6 to 1. This set up requires lighter hammers. On the other hand a very short blow distance and a very deep dip confirm very low AR usually around 5 to 1 or less. This set up can carry heavier hammer weight. If moving the knuckle placement alone doesn't achieve a satisfactory AR improvement then moving the capstans toward the pianist or installing a new corrected keyset are more in depth options to consider. For example, we routinely move knuckles to 17 mm and capstans forward on all Teflon era pianos to achieve a 5.5 ratio.

After touch/jack escapement is the jack moving away from the knuckle. Observe if it escaping by a large margin or is it not escaping at all? If there is too much after-touch, a longer blow distance or a shallower dip or both is required to limit jack escapement. If there isn't enough after touch a shorter blow and deeper dip are required to limit jack escapement.

Back of the key height. This determines damper lift height, back check height and amount of felt under the balance rail. It also determines the thickness of the felt and paper balance rail punchings on both rails. It determines the front key height as well.

Key height. The keys needs to fit under the fallboard but not above the key slip

Measure String heights each section- This is important for calculating hammer blow distance and if the pinblock is replaced, the plate needs to be relocated at the exact same height so the string plane is reproduced faithfully and that the action doesn't drag on the drop screws.

Measure Hammer Center pin heights.
The string height minus the Hammer center pin equal the hammers bore distance.

Action spread. Measure the distance between the Hammer and wippen center pins. This distance is commonly 111.5 mm to 114 mm on Steinways and other makes.

Wippen to capstan intersect:
The distance from the wippen center pin to the center of the capstan contact point is commonly 66mm when action geometry is set up right. Almost all wippens measure 99 mm from wippen center to jack center pin. So the intersect point is 2/3 the length of the wippen lever

Measure Hammer distance
Measure from the hammer flange center pin to the center of the molding on most Steinways and many others, is 130 mm/5 1/8″ but not always.

Hammer lines are not always straight.
Hammers in the 5th & 6th octave of all vintage Steinways benefit tonally in both power and sustain from a slightly curved strike line. Ask me for pictures. Other pianos may as well.

The convergence line
This is the point in the actions movement where the wippen capstan contact point intersect a line drawn from the center pin to the bottom of the balance pin when the parts are half of their overall rotational travel.

Measure Wippen flange center pin height .
These can vary and sometimes action elevation changes are needed.

With all the information collected it is possible to make an informed decision on which parts to choose and which hammer weight curve will work best. I want to point out that designing an action can be done many ways for many reasons. All these items covered so far give us guidelines as how to achieve the results that WE choose.
In the case of a client who has arthritis or other hand arm issues an action ratio in the 5.5 to 1 is preferred by many techs doing custom balanced actions or Stanwood style actions. I'd choose a knuckle placement that would achieve a 5.5 to 1 ratio and prepare a graduated hammer weight to match, in order to keep touch weight on the light side. I'd use a hammer weight curve in the 7 & 8 range on the Stanwood chart and aim for a balance weight of 35 or 37 which is appropriate here.