Study Guide to Prepare for Part 1 of the PTG Tuning Exam

Pitch

Tuning Fork

1. Use a steel (not aluminum) tuning fork. Determine at which temperature the fork will read exactly 0.0 on A4, read on the fundamental (1st partial) when electronically measured.
2. Listen first at the fundamental pitch. Match the unison as carefully as possible. Use the Sostenuto pedal to hold A4. If there is no Sostenuto pedal, use the damper pedal in the same manner as the Sostenuto pedal would be used.
3. Then compare with the test notes F2 and/or B1. For an explanation of how to use a test note, see step 3 in the Equal Temperament via Marpurg Sequence on page 7. Adjust these intervals for a conveniently wide and rapid beat. Compare beat rates with the test notes and A4, then the test notes and the tuning fork. Assure that both beat exactly alike. Then play all together and listen for any very slow beat which may emerge. Eliminate the slow beat if there is one.

Electronic Tone

1. No visual display is allowed. Use a tone that is soft, not loud. Make sure the tone will read exactly 0.0 when electronically measured at A4 on the fundamental (first partial).
2. Listen first at the fundamental pitch. Match the unison as carefully as possible. When the fundamental tone of the A4 string exactly matches the electronic tone, a faint, moderately rapid beat will be heard at the pitch level of E6.

Temperament

Typical 4ths & 5ths Sequence for Equal Temperament

All 5ths are *narrowed* by a small amount (theoretically 2 cents) from the point where they would be beatless (pure sounding).

All 4ths are widened by a small amount (theoretically 2 cents) from the point where they would be beatless.

All Major Thirds and Major 6ths are widened from the point of beatless by a moderate sounding rapid beat, (theoretically 14 cents).

All minor thirds are narrowed from the point of beatless by a very rapid beat (theoretically 16 cents).

M3 = Major 3rd M6 = Major 6th m3 = minor 3rd M10 = Major 10th

1. From the previously tuned A4, tune A3 as a 4:2 octave, using the test note F3. For an explanation of how to use the test note, see the instructions for step 3 in the Equal Temperament via Marpurg Sequence on page 7.
2. Estimate the A3-E4 5th.
3. Estimate the A3-D4 4th.
4. Estimate the G3-D4 5th.
5. Estimate the G3-C4 4th.
6. Estimate the F3-C4 5th.
7. Listen to the resultant F3-A4 M3. It should beat approximately 7 beats per second. If not, correct it and work back through the previous steps until no 4ths or 5ths beat too strongly or are too pure.
8. Compare the F3-A3 M3 and the F3-D4 M6. The M6 should beat slightly faster than the M3.
9. Estimate the E4-B3 4th.
10. Compare the F3-A3 M3 and the G3-B3 M3. The latter should beat slightly faster than the former. Compare the G3-B3 M3 and the G3-E4 M6. The M6 should beat slightly faster than the M3.
11. Tune the F3-F4 octave as a 4:2 type using the test note, C#3.
12. Estimate the F3-A#3 4th. This forms an A#3-D4 M3. It should beat slightly faster than the F3-D4 M6. It also forms a 5th between A#3 and F4. Compare the F3-A#3 4th and the A#3-F4 5th. They should sound similar but the 4th can be very, very slightly faster than the 5th but neither can beat more than 1 beat per second and neither can be perfectly pure.
13. Estimate the F#3-B3 4th. This forms a m3 with A3. It should beat very rapidly, slightly faster than the A3-C#4 M3 but slightly slower than the C#4-F4 M3. Compare the two CM3's, F#3-A#3 and A#3-D4 for a 4:5 ratio of beating.
14. Estimate the F#3-C#4 5th. This forms an A3-C#4 and C#4-F4 M3.
15. There are now 4 Contiguous Major Thirds (CM3). F3-A3, A3-C#4, C#4-F4 and F4-A4. Each pair of CM3's should have a 4:5 ratio of beating.
16. Compare the F3-A3, F#3-A#3 and G3-B3 M3's for an even progression. Also compare the A3-C#4 and A#3-D4 M3's for an even progression.
17. Estimate the G#3-C#4 4th. This forms a G#3-C4 M3.
18. Compare the two CM3's, G#3-C4 and C4-E4 for a 4:5 ratio of beating.
19. Check the evenness of all M3's from F3-A3 to A#3-D4.
20. Estimate the G#3-D#4 5th.
21. All notes of the temperament octave are now tuned. Check all 4ths, 5ths, M3's and M6's for evenness and progression of the M3's and M6's. Check all contiguous M3's. Check all M3-M6 combinations. Check all *inside* M3 and *outside* M6 combinations for equality. See Page 5, step 19 for an explanation of this test.

Tuning a Chain of Initial Contiguous M3's in Equal Temperament

The 4:5 ratio of beating of any two Contiguous Major Thirds (CM3) is a *small* difference.

1. Tune A4 to an A-440 pitch source.
2. Tune A3 to A4 as a 4:2 type octave. Use the test note F3. For an explanation of the test note, see the instructions in step 3 of the Equal Temperament via Marpurg Sequence on page 7. The test note for a 4:2 type octave is the note which is a M3 below the bottom note of the octave. It must form a conveniently heard *wide* M3 with the bottom note of the octave to be effective. When both the F3-A3 M3 and the F3-A4 M10 beat equally, the octave is proved to be a 4:2 type. Try also playing all three notes together after determining that the rapidly beating intervals beat equally. If a very slow beat can be heard to emerge, it will mean that the M3 and M10 are not quite equal.
3. *Estimate* the approximately 7 beats per second of the F3-A3 M3.
4. Tune F4 from F3 as a 4:2 type octave. Use the test note C#3.
5. Try to fit C#4 between A3 and F4 so that the two Contiguous Major Thirds (CM3) which are formed have a 4:5 ratio of beating between them. If C#4 cannot be properly placed, sharpen or flatten *both* F3 and F4 as needed. (See step 7 for further explanation). Remember to use the test note C#3 each time to insure that the F3-F4 octave is a 4:2 type. Adjust C#4 if necessary.
6. There will now be a chain of four CM3's: F3-A3, A3-C#4, C#4-F4 and F4-A4. Play all of these in *legato* (smooth and connected) fashion. Play in both ascending and descending patterns. No two CM3's may beat the same. If any do, it indicates a small error. If any two have the lower M3 faster than the upper, it indicates a larger error.
7. The top F4-A4 M3 beats very rapidly (approximately 14-15 beats per second). It literally sounds like a *buzz*. It is at or near the limit of discernibility so the only time you will need to listen to this interval is in this test. If it beats so fast that it sounds *"sour"* or beyond the point where you can discern the beats, it is too fast. In that case, the C#4-F4 M3 below it will inevitably beat much more slowly. This cannot be a 4:5 ratio, which is a *small* difference.

   On the other hand, if the F4-A4 M3 beats gently and can easily be heard, it is too slow. In this case, the C#4-F4 M3 below it will inevitably beat equally to it or faster which is not proper and will indicate anywhere from a small to larger error.

   There is one simple and steadfast rule: **If the top F4-A4 M3 is too fast, then the bottom F3-A3 M3 is too fast. If the top F4-A4 M3 is too slow, then the bottom F3-A3 M3 is too slow.**

   This gives you an easy clue as to how to correct an arrangement that is not quite proper. If the top interval is too fast, then you must sharpen both F3 and F4, which will narrow both M3's and thus make them beat more slowly. If the top interval is too slow, then you must flatten both F3 and F4, which will widen both M3's and thus make them beat more rapidly. In some cases after this correction, C#4 will fit as it was but most of the time you will also have to adjust C#4 very slightly to get a smooth chain of CM3's.

Once there is a solid chain of Contiguous Major Thirds from F3 to A4 established, there will be a very reliable foundation from which the rest of the temperament and midrange of the piano can be constructed. There are many sequences that can accomplish this but below are offered two of the most efficient and fool proof strategies. They both offer numerous and immediately available checks at each step towards the completion of the F3 to F4 Temperament Octave. There are no estimates made upon estimates which will result in cumulative errors and merely guessing at the solution. Each new note tuned is proven or disproven immediately.

Summary Sequence for Tuning the Initial Chain of Contiguous Major Thirds

1. Tune A4 to an A-440 pitch source.
2. Tune A3 from A4 as a 4:2 type octave.
3. Estimate the F3-A3 M3 at approximately 7 beats per second.
4. Tune F4 from F3 as a 4:2 type octave.
5. Place C#4 between A3 and F4 for resultant M3's, A3-C#4 and C#4-F4.
6. If the C#4 does not fit, adjust *both* F3 and F4 sharper or flatter so that it can.
7. Test all *four* CM3's ascending and descending several times in order to find and correct any small error.

The idea for the use of CM3's is attributed to Oliver C. Faust in the early 20th Century. He was a contemporary of Dr. William Braide-White and Cree Fisher whose books were more widely read but did not include the concept. There were earlier theorists such as 18th Century Friedrich Wilhelm Marpurg who also thought of the idea of dividing the octave into three equal parts but not that CM3's would have a 4:5 ratio of beating. The concept had virtually vanished from later 20th Century tuning practice until it was revived by such PTG laureates as Dr. Al Sanderson RPT, William Garlick RPT, Jim Coleman Sr. RPT and Rick Baldassin RPT. Today, it is considered an essential practice by most aural tuners.

Up a 3rd, up a 3rd, down a 5th Sequence for Equal Temperament

Don't be deceived by the title, you will *not* be pulling 3rds out of *thin air!*

1. Tune the A4 pitch and the initial chain of Contiguous Major Thirds (CM3). The three bottom notes of this chain, F3, A3 and C#4 are your first *up a 3rd*, *up a 3rd* sequence so now you move *down a 5th* from C#4 to F#3.
2. **From C#4, *estimate* an F#3-C#4 5th**.
3. **Checks**: F#3 now forms a very rapidly beating m3 with A3. It is slightly faster than the A3-C#4 but slightly slower than the C#4-F4 M3's above it. It should merely sound *similar* to these but not slower than the lower and not faster than the upper. *Similar* is good enough at this point because F#3 may have to be slightly adjusted after the next step. Compare the F#3-A3 m3 with the A3-C#4 M3. The m3 should beat slightly faster than the M3.
4. Move *up a 3rd* to A#3 and ***estimate* the F3-A#3 4th**.

5. **Checks**: There are now two chromatic M3's. F3-A3 and F#3-A#3. Check for a very slight *progression*. The actual ratio is 15:16. This is a *very small difference* as compared to the *small difference* of the 4:5 ratio of CM3's. Chromatic m3's also have the same 15:16 ratio and contiguous m3's also have the 4:5 ratio of beating. If the two M3's do not progress properly, check first the F#3 as tuned from C#4 and then A#3 as tuned from F3 to determine if either or both can be adjusted slightly to improve the progression. (See step 19, paragraph 2 for a solution if at this point, an even progression seems not to be possible). There are now two intervals of a 5th to compare for similarity: F#3-C#4 and A#3-F4.
6. Move *up a 3rd* to D4 and ***estimate* the A3-D4 4th.**
7. **Checks:** There are now two more pairs of chromatic M3's: A3-C#4 and A#3-D4. Check for a *progression* as described in step 5. There is also another pair of CM3's: F#3-A#3 and A#3-D4. There is also a M3-M6 combination: F3-A3 M3 + F3-D4 M6. The M6 will beat slightly faster than the M3. There are also two intervals of a 4th to check for similarity: F3-A#3 and A3-D4. There are also three intervals of a 5th to check: F#3-C#4, A#3-F4 and D4-A4. If any of the checks are not proper, do not just move a note indiscriminately. Look for the *source*. Consider that F3, A3 and C#4 are the most reliable. Consider a slight adjustment of any note tuned directly from those.
8. Move *down a 5th* from D4 and ***estimate* the G3-D4 5th.**
9. **Checks:** G3 now forms a m3 with A#3. Check for the similarity but very slight progression of the F#3-A3 and G3-A#3 m3s. The G3-A#3 m3 will beat almost as fast as the C#4-F4 M3. There are three intervals of a 5th to check for similarity: F#3-C#4, G3-D4 and A#3-F4.
10. Move *up a 3rd* to B3 and ***estimate* the F#3-B3 4th.**
11. **Checks:** There are now three chromatic M3's in a row: F3-A3, F#3-A#3 and G3-B3. There are also three intervals of a 4th to check for similarity: F3-A#3, F#3-B3 and A3-D4.
12. Move *up a 3rd* to D#4 and ***estimate* the A#3-D#4 4th.**
13. **Checks:** There are now three more chromatic M3's in a row: A3-C#4, A#3-D4 and B3-D#4. There is another pair of CM3's: G3-B3 and B3-D#4. There are also two M3-M6 combinations: F3-A3 M3 + F3-D4 M6 and F#3-A#3 M3 + D#4. There are now four intervals of a 4th to check for similarity: F3-A#3, F#3-B3, A3-D4 and A#3-D#4. Minor thirds above C4 as the top note are generally beyond the limit of discernibility, so they can be dismissed.
14. Move *down a 5th* to G#3 and ***estimate* the G#3-C#4 4th.**
15. **Checks:** Compare the G#3-D#4 5th and the G#3-C#4 4th as the first check. G#3 forms a m3 with F3 so there are now a whole row of m3's from F3 to C4. Compare the four intervals of a 5th: F#3-C#4, G3-D4, G#3-D#4 and A#3-F4. Compare also the five intervals of a 4th: F3-A#3, F#3-B3, G#3-C#4, A3-D4 and A#3-D#4.
16. Move *up a 3rd* to C4 and ***estimate* the F3-C4 5th.**
17. **Checks:** Compare the F3-C3 5th and the G3-C4 4th first. There are now a whole row of chromatic M3's from F3 to D#4. There is another M3-M6 combination: G#3-C4 + G#3 F4. Chromatic and contiguous m3's may be checked from F3 to C4. There are now four intervals of a 5th to be compared for similarity: F3-C4, F#3-C#4, G3-D4, G#3-D#4

and A#3-F4. There are now seven intervals of a 4th to compare for similarity: F3-A#3, F#3-B3, G3-C4, G#3-C#4, A3-D4, A#3-D#4 and C4-F4.

18. Move *up a 3rd* to E4 and ***estimate* the A3-E4 5th.**
19. **Checks:** Check first the A3-E4 5th and the B3-E4 4th. All other possible checks are now available. Compare similarity of all intervals of a 5th and all intervals of a 4th. Compare all CM3's. Compare all chromatic M3's. Compare all m3's up to C4 and as far beyond that as is discernible. Compare all M3 + M6 combinations. Compare all "*inside 3rd + outside 6th*" combinations. Example: G3-B3 M3 + F3-D4 M6. These should actually seem to beat equally. They are the only test which actually does beat equally aside from using the test notes for the initial octaves of A3-A4 and F3-F4. This test is best reserved for last because it will be difficult to know which note or notes will be at fault if the two intervals do not be equally. Prove which note or notes are at fault before moving them!

    While the initial chain of CM3's is considered to be very reliable and the notes within it the most certain as the sequence progresses, there are always two possibilities: 1. It was not constructed initially as precisely as it was believed to be. 2. Any of those notes which may have changed, even by one cent or less can ruin the foundation. If at any time during the sequence, nothing seems to be working, consider starting from the beginning. It will not be difficult and everything will fall into place nicely and easily after correcting the foundation.

Summary Up a 3rd, Up a 3rd, Down a 5th Sequence

1. Tune the A4 pitch and initial chain of CM3's.
2. Estimate F#3 from C#4. Check.
3. Estimate A#3 from F4. Check.
4. Estimate D4 from A3. Check.
5. Estimate G3 from D4. Check.
6. Estimate B3 from F#3. Check.
7. Estimate D#4 from A#3. Check.
8. Estimate G#3 from C#4. Check.
9. Estimate C4 from F3. Check.
10. Estimate E4 from A3. Check.

The idea for the *Up a 3rd*, *Up a 3rd*, *Down a 5th* sequence is attributed to PTG Co-founder, John Travis RPT.

Equal Temperament via Marpurg Sequence

1. Tune the A4 pitch and the initial chain of Contiguous Major Thirds (CM3). The three lower notes, F3, A3 and C#4 will be the *core* notes, the *A list* notes which will be the most reliable and provide the foundation for the temperament. Tune them very carefully and check them forward and backward before proceeding.
2. From each of these three lower notes, F3, A3 and C#4, you will temporarily tune a beatless (pure or just) 4th and a 5th. It is important that these intervals, although *temporarily* tuned as beatless, must be proved to be beatless for the concept to work. There is a test note for each interval which effectively serves as the check.
3. The test note is defined as an *untuned* note that merely serves as a reference. It however cannot be very far off from its ultimate pitch to be effective. Therefore, if attempting or practicing for the PTG tuning exam or using this sequence to tune a piano which is any more than very slightly off pitch, the test note *must* be moved to what is known as a *convenient* position. That is, it must be approximately tuned first.
4. The test note for a beatless 5th is the note that will make the 5th a minor triad or otherwise stated, a M3 below the top note of the interval. When testing a 5th, move the test note to where it forms a conveniently and rapidly beating *wide* M3 with the top note of the interval.
5. The test note for a beatless 4th is the note a M3 below the bottom note of the interval. Move the test note to where it forms a conveniently and rapidly beating *wide* M3 below the bottom note of the interval.
6. From F3, temporarily tune A#3 as a beatless 4th with F3. Use the test note, C#3.
7. From F3, temporarily tune C4 as a beatless 5th with F3. Use the test note, G#3.
8. From A3, temporarily tune D4 as a beatless 4th from A3. Use the test note, F3.
9. From A3, temporarily tune E4 as a beatless 5th from A3. Use the test note, C4.
10. From C#4, temporarily tune F#3 as a beatless 5th from C#4. Use the test note, A3.
11. From C#4, temporarily tune G#3 as a beatless 4th from C#4. Use the test note, E3.
12. There are now three notes remaining which have not yet been attempted to be tuned. They are G3, B3 and D#4. Notice that these are each one full step above the *A list* notes: F3, A3 and C#4. That is a good way to remember what they are.
13. Each of these notes will be placed equidistantly between two notes that have temporarily been tuned as beatless intervals. One of the temporarily tuned notes will effectively been tuned 2 cents sharp and the other 2 cents flat as beatless intervals. By placing the next three notes equally beating between those notes, they will end up being precisely where they should be. They will be the *B list* notes.
14. Tune G3 so that it beats equally with the C4 and D4 above it. Both of these beats will sound stronger than they will be ultimately because they will be 4 cent intervals at this point. Either interval may be temporarily tuned approximately beatless first (no need to prove it this time) but when compared with the other note, it will beat strongly. Simply find the point where both the G3-C4 4th and the G3-D4 5th beat exactly alike or equally. It is neither an estimate nor a guess. When it is determined that both the 4th and the 5th sound alike (equally beating and equally out of tune), play all three notes together. It

will most likely be heard that the beat seems to be largely canceled if the two intervals are equal. A pulse may be heard at first but then it appears to be *swallowed*.

15. Tune B3 likewise between F#3 below it and E4 above it. The F#3 is 2 cents flat as it was tuned as a beatless 4th from C#4. The E4 is 2 cents sharp as it was tuned as a beatless 5th from A3. Placing B3 equally beating between F#3 and E4 will put B3 in exactly the right position.
16. Tune D#4 likewise between G#3 and A#3 below it. G#3 is 2 cents sharp as it was tuned as a beatless 4th from C#4. A#3 is 2 cents flat as it was tuned as a beatless 4th from F3. Placing D#4 equally beating between G#3 and A#3 will put it in exactly the right position.
17. Remember that when G3, B3 and D#4 are tuned equally beating, those equally beating intervals will all beat at twice the rate that they will ultimately. They may sound incorrect because at this point, they are but the notes G3, B3 and D#4 have found their correct position. They are now the ***B list*** notes and they are just as reliable as the ***A list*** notes, F3, A3 and C#4.
18. At this point, the chromatic M3's from F3-A3 to D#4-F4 may be played. If all has been done correctly, they will sound the very same as a perfected equal temperament. How can this be when fully half of the notes are either 2 cents sharp or flat? F3-A3 is correct but *both* F#3 and A#3 are 2 cents flat. They are the proper 14 cents wide but both notes of the interval must be sharpened. G3 and B3 are correct. They are among the ***B list*** notes. G#3 and C4 are both sharp by 2 cents. They are 14 cents wide but both notes are 2 cents sharp of where they must ultimately be.
19. If the 4ths and 5ths are played, they will sound uneven. The beatless intervals will sound acceptable but those which are 4 cents wide or narrow will not. At this point, the temperament is an adaptation of the temperament found in the second publication by Professor Owen Jorgensen RPT, *The Handbook of Equal Beating Temperaments*. It is commonly called the *Marpurg Temperament* but its full same is the *Marpurg-Neidhardt Quasi Equal Temperament*. The adaptation is that the original sequence was transposed from C3-C4 to F3-F4 and the CM3's were altered from equally beating (as Marpurg thought they should be) to the proper 4:5 ratio of CM3's. This adaptation was initiated by members of the PTG, so it may be properly called the *Marpurg-Neidhardt-PTG Quasi Equal Temperament*. Now, on to the adjustment to Equal Temperament.
20. The six intervals which were temporarily tuned as beatless must now be corrected. Go back to those: A#3 & C4 from F3, D4 & E4 from A3 and F#3 & G#3 from C#4. Each of these notes were tuned temporarily beatlessly from an ***A list*** note. Each note will be compared to and adjusted from a ***B list*** note.
21. Compare A#3 to F3 and D#4. The F3-A#3 4th is beatless but the A#3-D#4 4th is 4 cents wide and noticeably beating. Sharpen A#3 until both intervals of a 4th, F3-A#3 and A#3-D#4 beat equally. A#3 will now be in its proper place. Both intervals of a 4th will now sound as they should for equal temperament.
22. Compare likewise C4 to F3 and G3. Flatten C4 until both the F3-C4 5th and the G3-C4 4th beat equally.
23. Compare D4 to A3 and G3. Sharpen D4 until both the G3-D4 5th and the A3-D4 4th beat equally.

24. Compare E4 to A3 and B3. Flatten E4 until both the B3-E4 4th and the A3-E4 5th beat equally.
25. Compare F#3 to C#4 and B3. Sharpen F#3 until both the F#3-B3 4th and the F#3-C#4 5th beat equally.
26. Compare G#3 to C#4 and D#4. Flatten G#3 until both the G#3-C#4 4th and the G#3-D#4 5th beat equally.
27. Final check: Play all intervals looking for any unevenness. If an error is found, look first to determine if the notes tuned temporarily beatlessly were not properly equalized with the corresponding note from the *B list.* Then try all other tests as are listed in step 19 of the *Up a 3rd*, *Up a 3rd*, *Down a 5th* sequence.

Summary Sequence for the Equal Temperament via Marpurg

1. Tune the A4 pitch and the initial chain of CM3's.
2. From F3, temporarily tune a beatless 4th with A#3 and beatless 5th with C4,
3. From A3, temporarily tune a beatless 4th with D4 and a beatless 5th with E4.
4. From C#4, temporarily tune a beatless 5th with F#3 and a beatless 4th with G#3.
5. Tune G3 equally beating between C4 and D4.
6. Tune B3 equally beating between F#3 and E4.
7. Tune D#4 equally beating between A#3 and G#3.
8. Return to A#3 and tune it equally beating between F3 and D#4.
9. Return to C4 and tune it equally beating between F3 and G3.
10. Return to D4 and tune it equally beating between G3 and A3.
11. Return to E4 and tune it equally beating between A3 and B3.
12. Return to F#3 and tune it equally beating between B3 and C#4.
13. Return to G#3 and tune it equally beating between C#4 and D#4.

One small clarification must be mentioned. The Equal Temperament via Marpurg sequence technically remains a *Quasi Equal Temperament*. *Quasi* means *almost*. Theoretically, 4ths and 5ths cannot be equally beating, the same as all M3s, even though they are each 14 cents wide cannot beat equally. The reason is that temperament is on a logarithmic scale rather than linear. That being said, the actual difference between having all intervals of a 4th and 5th beat equally and the 30% faster that a 4th should beat than a 5th is such an extremely small difference that it truly is inconsequential. 30% faster than very slow is still very slow.

If the Equal Temperament via Marpurg is tuned perfectly and correctly as described, it will score a perfect 100% on the tuning exam. The actual difference is that small. It is, for all intents and purposes, Equal Temperament. It sounds and functions as Equal Temperament. There are other factors such as inharmonicity which also alter virtually any attempt at tuning Equal Temperament from the way it would be theoretically. So, it may well be for many technicians

that an attempt at the Equal Temperament via Marpurg would yield more seemingly perfected results than most any other strategy.

That being said, there are actually advocates of equalizing the intervals of a 4th and 5th completely aside from the Equal Temperament via Marpurg sequence. There are also advocates of creating an equal temperament within the range of a beatless octave-5th (pure 12th) rather than an initial F3-F4 octave tuned as a 4:2 type. This also alters the relationship between the intervals of a 4th and 5th and causes them to be more unlike than alike.

There are also those who advocate widening the temperament octave to such an extent that there is an audible beat within it for the sake of having all of the intervals of a 5th sound beatless. The consequence of either of the above is that the intervals of a 4th will beat more noticeably and the M3's and M6's will beat more rapidly as well.

These are all choices that one may make in order to obtain a desired effect depending upon the circumstances. The effect of making the choice of an initial 4:2 octave with equally beating intervals of a 4th and 5th within it will be a calmer effect. One may make all octaves, intervals of a 4th and 5th seem to beat equally as well. The extensions of these, the octave 5th, double octave, double octave-5th and triple octave can all be easily reconciled. The final result is a very *clean* sound.

If the purpose for learning and using the Equal Temperament via Marpurg is for passing the PTG tuning exam and the choice has been made because no other strategy has been personally successful, then the merit of that stands alone in its value.

However, what I have found is that this particular choice of temperament and octave stretch that serves to reconcile so many widely dispersed intervals is particularly good when the music to be played covers a wide area of the keyboard and features complex harmonies, frequent modulations and polyphony. I am well known for mostly tuning using a Victorian style Well Temperament but when the choice is to tune Equal Temperament, this is the particular combination of slight temperament variation and stretch that I use.

You, as a technician, are free to compare this idea with any other that you may have heard of or attended presentations. What is most important to you, as an attendee of this presentation is that to follow it to the letter will yield very high, if not perfect scores on the PTG Tuning Exam.

If you are interested to hear an entire Jazz concert with a Kawai RX-3 tuned in the ET via Marpurg Temperament, you can do so by visiting this link:

http://www.madtoastlive.com/latest/2013/3/10/episode-280-johannes-wallman.html

You may also find it by Googling "Mad Toast Live", click on the "Episodes" tab and go to Episode 280, Johannes Wallman (the pianist). If you like the music, I suggest you click the download tab because it may not be available indefinitely. It has all original pieces which were composed by the pianist, a Professor of Jazz performance at the University of Wisconsin. The musicians are

all of very high caliber but the playing may not suit everyone's taste. It is also an unusual combination of instruments. All of that is discussed between the artists and the hosts.

You may only be interested in how the piano sounds but do not expect it to sound in any way radically different. It should sound clear and well defined. The pianist often plays very complex chords that are incisively dissonant. The choice of temperament and stretch serves to bring clarity to what may otherwise sound merely chaotic.

If, in the future, you wish to program your electronic tuning platform to tune the ET via Marpurg, here are the offsets, first in hundredths, then in tenths for Sanderson Accutuner devices:

C: -0.05 (-0.1) C#: 0.00 (0.0) D: -0.16 (-0.2) D#: -0.78 (-0.8) E: -0.50 (-0.5) F: 0.00 (0.0)
F#: +0.60 (+0.6) G: +0.56 (+0.6) G#: -0.05 (-0.1) A: 0.00 (0.0) A#: +0.16 (0.2) B: +0.56 (0.6)

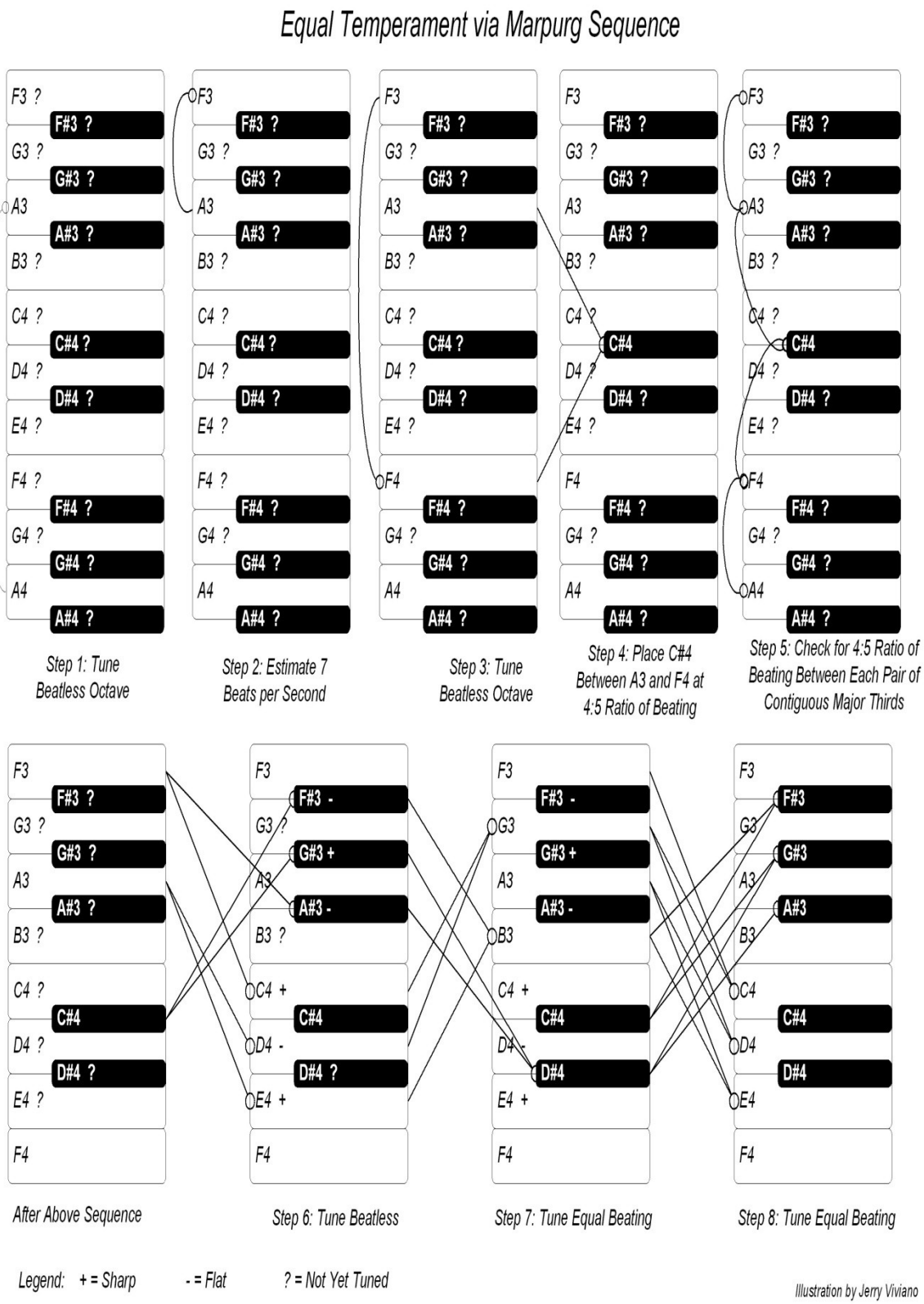
You see that each deviation is *very* small! F, A and C# are the same as standard ET. All of them fall *within* the +/- 0.9 cent tolerance of the PTG Tuning Exam. Only D# gets close to the limit of tolerance but with the Pitch Correction Number shift of your actual temperament readings and aural verification, if the examiners find that they cannot really improve D# or any other notes which may receive an initial electronically scored error, it will be nullified.

The true beauty of the ET via Marpurg sequence is that it tends to self-correct. This means that if you have been struggling with aural tuning and beat perception, the sequence itself tends to keep you much more on track than if you tuned by 4ths & 5ths alone and compounded errors which cannot be reconciled.

Completing the Midrange

This will now be relatively easy. Whichever temperament sequence has been chosen, the strategy is basically the same.

1. Descending from F3, tune E3 first as a reasonable sounding octave. Then compare it to the 4^{th} and 5^{th} above it. If the 4:2 type initial octave has been used, the octave, 4^{th} and 5^{th} will all have approximately the same sound as far as tempering goes. No interval is perfectly pure but none beats noticeably either. Compare chromatic and contiguous M3's and m3's.
2. Continue likewise with D#3, D3 C#3 and C3. When those five notes have been tuned, play all intervals as it was done to test the temperament octave.
3. Ascending from F4, tune F#4 as a reasonable sounding octave, then compare the 4^{th} and 5^{th} below it and also make all three intervals sound basically alike. Use M6's and M10's as rapidly beating interval checks.
4. Continue likewise to B4 but remember that A4 has already been tuned.


Equal Temperament via Marpurg Sequence
Step 1: Tune Beatless Octave
Step 2: Estimate 7 Beats per Second
Step 3: Tune Beatless Octave
Step 4: Place C#4 Between A3 and F4 at 4:5 Ratio of Beating
Step 5: Check for 4:5 Ratio of Beating Between Each Pair of Contiguous Major Thirds
After Above Sequence
Step 6: Tune Beatless
Step 7: Tune Equal Beating
Step 8: Tune Equal Beating
Legend: + = Sharp - = Flat ? = Not Yet Tuned
Illustration by Jerry Viviano

Tips for completing Parts 2 and 3 of the PTG Tuning Exam

Although this presentation is exclusively about passing Part 1 of the PTG Tuning exam, the part that is most often failed and the most difficult to pass, I will offer some suggestions about going on to pass Parts 2 and 3:

Part 2 electronically:

- If you normally tune with an electronic tuning platform, do not be discouraged if you have failed Part 1. You can still pass parts 2 and 3 and retake Part 1 later.
- Find out how close or not you came to passing Part 1 and resolve to further study and practice before you again attempt Part 1.
- If you normally tune electronically, in Part 2, simply program your platform as you usually do and simply "run over" the midrange and then proceed to the outer octaves.
- You should probably program your platform to tune Octave 1 with 8:4 octaves if you know how. The default program may do that for you if you do not know how to tell it to do that. The tolerances are rather wide in that area, so default programs generally suffice as long as you tune according to them accurately.
- Tune octaves 5 and 6 as your platform tells you but be accurate!
- In octave 7, if you know how to tell the platform to tune 2:1 octaves, do so. If not, see the next line for a tip on what to do.
- When you reach C7, play the C6 key and stop the pattern on your platform which is reading on C7. Tune to whatever value it says. If your platform automatically shifts to the actual note played (C6), disable that function at that point. What you are trying to do is find the exact pitch of the second partial of C6 and tune to that which will create a perfect 2:1 octave between C6 and C7. Continue that way up to B7, the last note which will be tested. (C8 is not tested).

Part 2 Treble and High Treble aurally:

- First, try to correct any errors that were noted in Part 1. You may ask to have the scoring sheet to identify which they were. Your outer octave results will be measured upon a *re-reading* of the temperament octave before scoring the outer octave results! It will not change your previous score, whether passing or failing but the re-reading of the temperament octave can affect the scoring of the outer octaves. This is why I recommended to people who choose the electronic option to simply "run over" what had previously been done aurally with the electronic program.

- There is a very simple and effective way to precisely tune the outer octaves at the PTG Tuning Exam since all notes have the outside strings muted and you are only required to tune the middle string of each note.
- Starting with C5, tune what sounds like a reasonable octave, no real beat in it but to the wide side rather than narrow. Compare the 4th and 5th below it and make all three: the octave, 5th and 4th sound about the same. Then, you may try Major 10ths to confirm a smooth progression. Do this until you reach F5.
- At F5, again tune what sounds like a reasonable octave first, no noticeable beat but on the wide side rather than narrow. Then, using the *Sostenuto* pedal, play the double octave, F3 and F5 and then play the octave-5th , A#3 (B-flat 3) and F5. Adjust F5 until all three intervals, F4-F5, F3-F5 and A#3-F5 all sound about the same. They will all sound "apparently" in tune but the octave and double octave will be technically very slightly wide and the octave-5th very slightly narrow but there will be no "beating" in any of them. You may confirm the result with a Major 17th test for a smooth progression. Do the same all the way to B6.
- When you reach C7, simply tune the purest octave that you can. You may test with the M10th below C6 and listen to hear of the 10th between G#5 and C6 and the 17th between G#5 and C7 sound the same. You can continue this at least half way through the 7th octave but at some point, the rapidly beating interval test may become indiscernible.
- At that point, you need to simply tune as pure octaves as you can. You can sometimes play the note to be tuned and it will excite the octave below it. You want to hear a pure and beatless unison with that note, whether you play it or not.
- Each of these notes will be very significantly detuned, so you first have to get the note you are tuning within a reasonable range. Playing an arpeggio may help get the note to be tuned within range. The best approach for tuning the very highest notes is to listen simply for a pure sounding octave. The tolerance range is quite high and there are only 12 notes in this section, so some significant errors can be made and still pass. You only want to do your best.

Tuning the Bass aurally in Part 2:

- It is not important whether you tune the Bass first or last. It is simply a matter of preference so if you decide to proceed downward first, that is your choice and it will not affect your overall results.
- Starting with B2, tune what sounds like a reasonable octave but again to the wide side rather than narrow. Check with the 4th and 5th above it so that the octave, 4th and 5th all sound about the same. None have obvious beats! Continue this until you reach C2.
- You may confirm your results for a smooth progression with 10th's and then 17th's as you progress lower. Use whichever rapidly beating interval tests that you can hear most clearly. Do the same until your reach F2.
- At F2 and below, again first tune what sounds like a reasonable octave, then skip the 4th and 5th tests because the will become too "growly". Again, use the *Sostenuto* pedal as described for the Treble section. Play the double octave, F2-F4 and compare it with the

octave-5th, F2-C4. Make all three intervals, the octave, double octave and octave-5th sound about the same.

- You may confirm the results with M17th tests for a smooth progression.
- Beginning with C2 and on down to the very lowest note to be tested, C1 (A0, A#0 and B0 are not tested), continue first in making a reasonable sounding octave. The detuning will be quite significant, alternately sharp and flat, so you have to start somewhere.
- You can, at this point, simply press the damper pedal and tune the octave to where it sounds best in tune to you.
- The higher partials of these notes will be audible, so you will probably hear a "resonance" that will actually be a conflict between the 8th and 16th partials of the note to be tuned and the octave above it. The difference can be as much as 20 cents! However, that clash, as it were, does not sound, "out of tune" but more like the rapidly beating intervals that occur above them.
- There is a particular place for each of these very low notes that sounds in tune with the whole rest of the piano above them. The very easiest way to find that place is to simply press the damper pedal and tune those low notes until they resonate well with everything above them.
- There is a good rapidly beating interval test for the lowest octave but even 17th's do not suffice. They become too slow to judge. It is at the point of C2 that you should switch to the *double octave-minor 7th!* It is a widened interval just the same as the 3rd, 10th and 17th are. At C2, you will play C2 and A#4 (B-flat 4) and check the lowest octave for a smooth progression to C1.

Tips for Passing Part 3 of the PTG Tuning Exam:

- The PTG Tuning Exam is now divided into three parts and this can help people who have only struggled with one part of it. If you missed passing Part 1 or even if you failed Part 3 which now is only Unisons and Stability, you may retake only the part you missed, currently within a one year time period but that period may well be extended pending rules adjustments. You may also have up to two attempts at the parts you missed which is on the current Council agenda.
- Part 3 concerns only the tuning of unisons between C3 and B4. The pitch of each unison is ignored which is in your favor. In other words, it will not matter if each pitch has been pounded flat or sharp of what it should be, only that the unison is found to be "pure" sounding.
- You must try to make each and every unison in that section have the most "pure" sound that it can have and you can only do that aurally. No electronic platforms are allowed. The "pure" sound means that no detectable beat is acceptable. There is a tolerance, of course but the goal is an absolutely beatless unison.
- The Stability test will follow and it will be upon the *outside* strings, either right or left of each unison. That means that you must also do whatever you can to insure that each of the left and right strings of each unison will remain stable after a standardized device is used to deliver test blows to each and every unison.

- Each unison is tested but whether it is the right or left string of each that is tested is chosen at random. Therefore, you need to make sure, the best that you can, that both the right and left string of each unison will not only be in tune with the center string but also hold up to a vigorous test blow.
- The kind of tuning hammer technique you may have is a whole other subject for discussion so I cannot address the pros and cons of that in this document alone.
- I can only say that you need to have developed adequate "tuning pin setting techniques" to be successful. This means that arriving at a correct pitch is not enough if the pitch will change under a hard test blow.
- There are essentially two types of hammer technique: the "slow pull" method or the "impact" method.
- The slow pull method is the most often attempted and preferred but it has several problems. If the tuning pin is very tight within the pinblock, a slow pull will naturally twist the tuning pin and create uneven tension upon the various lengths of the piano string. It is then necessary to counteract all of those problems with subsequent manipulation of the tuning pin and test blows.
- The impact type technique is much more direct in moving the entire tuning pin and all of the various segments of the piano string at once. There are two problems with that kind of approach, however: Many technicians say they cannot precisely control an impact type technique. The technique in itself, while greatly reducing tuning pin twisting and string segment uneven tension, is not universally effective.
- The technician needs to decide personally which kind of hammer technique is most effective. In either case, to be able to pass the Stability part of the PTG Tuning Exam, the tuned string *must* be able to withstand three very vigorous test blows! A change of +/- one cent or more will mean a failed stability test. Only 5 such failures out of 24 unisons are allowed before a score of less than 80 is assigned.
- The bottom line is that a score of 80 or above must be achieved in each category of the PTG Tuning Exam to be successful.

Partial retakes of the exam:

Currently, if Part 1 and/or Part 3 are failed, each may be retaken within a 25 month (2 years + 1 month) period and there are two opportunities allowed for each before the entire exam must be retaken. If only Part 2 is failed, Part 1 must also be retaken since the scores on Part 1 are tied to Part 2. If both Parts 1 and 3 are failed but only Part 2 passed, the entire exam must be retaken. Otherwise, if only Part 1 and/or Part 3 are failed, they may be retaken within the 25 month period. According to the current rules, if more than one part of the exam must be retaken, both failed parts must be retaken together in the same session. If one of those parts is passed, there will still be one more opportunity to retake the part which remains with a 25 month period from when the exam was initiated.

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