BASIC PIANO TUNING
by
Mark Cerisano, RPT

howtotunepianos.com
BASIC PIANO TUNING COURSE
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Welcome to Basic Piano Tuning. Learning to tune a piano can be a difficult task but this course is designed to make it as easy as possible. In this class you will learn two basic skills. One easy; the other will take much more time than we have here to master. The easy skill will be where to put the hammer and what notes to tune and when. The hard part will be hearing and comparing the beats. Without being able to hear the beats produced by un-pure intervals, it is impossible to be a great tuner. (We will discuss what beats and un-pure intervals are soon) This class will give you many tricks that should ease the challenge of hearing these beats.

This is a course in aural piano tuning. There are other ways to tune a piano, but if you can tune a piano aurally, you will be a better tuner than if you went straight to an Electronic Tuning Device (ETD).

The course is organized from the beginning of tuning a piano to the end. We will concern ourselves mostly with upright pianos for two reasons. One, uprights are much more prevalent than grands and two, beginner tuners usually tune only uprights until their skills are better. We will talk about grands and try tuning one if it is available at the school.

You will be asked to hear the beats produced by un-pure intervals right from the beginning and you will spend the rest of the course trying to improve your ability to hear these beats. Relax. You will never hear these beats by trying too hard. Stay relaxed and focused. Do not spend too much time trying to hear any one interval’s beat. If you are having difficulty, change it up and listen to something else. The skill will come as long as you keep trying to listen. Try to always listen from a relaxed frame of mind. If you are having difficulty, take a break.

Many students report the sensation of time slowing down when they are tuning; many are surprised when they are told the class has finished. Indeed the instructor often goes overtime without being aware; that is how intoxicating tuning can be.

Good luck with the class and I hope you all find the class interesting, your expectations exceeded, and learning new skills; successful.

Mark Cerisano, RPT
GENERAL OUTLINE of CLASS PROGRESSION
This manual and the class will follow this order of topics.

CHAPTER I - General Concepts
1.1 Tuning Tools
1.2 Note Nomenclature
1.3 Pure, Wide, and Narrow Intervals (introducing the Harmonic Series)
1.4 Design of the Piano
1.5 Basic Tuning Procedure

CHAPTER II - Muting the Piano
2.1 Creating Single Strings (Upright Piano)
2.2 Muting the Bichords (Upright Piano)
   2.2.1 Muting the Bichords When They End at the Tenor Break (Design #1)
   2.2.2 Muting the Bichords When They End in the Tenor Section (Design #2)
   2.2.3 Muting the Bichords When They End in the Bass Section (Design #3)
   2.2.4 The Treble Section
2.3 Muting the Grand Piano

CHAPTER III - Tuning A4 to the Fork
3.1 Sounding the Fork
3.2 Turning the Tuning Pin
3.3 Unison Concepts
   3.3.1 Unison Theory
3.4 Equal Temperament Brief Introduction
3.5 Using the A4 Check Note to Improve Your Tuning of A4
3.6 Techniques for Hearing Beats
3.7 Stability

CHAPTER IV - Tuning the First Octave, A3A4
4.1 Different Octave Sizes
4.2 How to Tune a Proper Octave for A3A4 using Check Notes
4.3 Stretch and Inharmonicity

CHAPTER V - Tuning the Temperament, F3F4
5.1 Different Temperaments
5.2 Cycle of Fourths and Fifths Temperament (Basic Temperament)
5.3 Wide Noisy Fourths and Narrow Rolling Fifths and What They Sound Like
5.4 Basic Refining Techniques
5.5 Using Fourths and Fifths to Refine
5.6 Using Thirds and Sixths to Refine
5.7 Important and Useful Considerations for Tuning the Temperament
   5.7.1 The White Anchor
   5.7.2 The Skeleton
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CHAPTER I - GENERAL CONCEPTS

1.1 Tuning Tools

These are the required tools for Basic Piano Tuning.

TUNING HAMMER

TUNING FORK

THREE FELT MUTE STRIPS formuting outside unison strings

2 PAPP’S MUTES for selective muting of strings, especially where there is no room above hammers.

8 RUBBER WEDGE MUTES for muting strings of notes at ends of sections.
1.2 Note Nomenclature

BLACK KEYS
Tuners generally don’t use flats (b) to name the black keys, just sharps (#). This produces some musically unusual combinations, like F – A# for a perfect fourth.

Exception for this text: I will use flats when we are discussing topics that are also common as musical forms. For example: Appendix G - Cycle of Fifths uses flats because the Cycle of Fifths is a common musical form for practicing, composing, and improvisation.

NAMING NOTES
There are two common systems used to name the notes of the piano for tuning purposes:

System 1
Each octave gets its own number.
Octaves are C to B
The bottom three notes and the top note have their own octave number.
The bottom octave is numbered zero (0).
So, the first three notes are A0, A#0, B0
Then the next octave is C1 C#1 D1 D#1 E1 F1 F#1 G1 G#1 A1 A#1 B1
Then the octaves follow up to number 7.
The top note is C8

System 2
Some tuners just name the letter name of the note and add the number of the key.
For example: A1, A#2, B3, C4, C#5, etc…up to C88.

For this book we will use System 1

Some common notes to remember using System 1:
The pitch of the tuning fork A440 is found at A4.
Middle C is C4
Our first complete octave we will tune is the temperament octave, F3F4

Occasionally, I will describe notes with their frequencies if we are discussing frequencies. For example: A4 may be listed as A440, and A3 as A220, etc.
1.3 Pure, Wide, and Narrow Intervals

This can be a tricky concept to grasp but the sooner you do grasp it, the easier other things will be to understand. In order to understand these terms, it is necessary to introduce the harmonic series now. The harmonic series is a concept that we will come back to often, so it too requires effort on your part to really know it inside and out; be able to name all the notes in any harmonic series easily. 

(See Appendix A – Harmonic Series and Tone. Worksheet and Answer Sheet)

HARMONIC SERIES
Whenever a note is played, there are actually many frequencies produced. The note we hear is called the Fundamental or 1\textsuperscript{st} Partial. The other frequencies produced are called the 2\textsuperscript{nd} partial, 3\textsuperscript{rd} partial, 4\textsuperscript{th} partial, etc.

The musical intervals of the partials above the fundamental are:

- Fundamental or 1\textsuperscript{st} Partial – Unison (The note we hear)
- 2\textsuperscript{nd} Partial – Octave
- 3\textsuperscript{rd} Partial – Octave plus perfect fifth
- 4\textsuperscript{th} Partial – 2 octaves
- 5\textsuperscript{th} Partial – 2 octaves plus M3
- 6\textsuperscript{th} Partial – 2 octaves plus P5
- 7\textsuperscript{th} Partial – 2 octaves plus m7
- 8\textsuperscript{th} Partial – 3 octaves

Notice:
- 2, 3, 4 make a common left hand pattern in piano music (an octave with the fifth inside)
- 4, 5, 6 make a major chord
- 4, 5, 6, 7 make a dominant chord (7\textsuperscript{th} chord)

PURE INTERVALS AND BEATING INTERVALS
(The term pure refers to the sound of an interval and must not be confused with the term perfect. We can have a perfect fifth that is not pure.)

In the ideal world, the frequencies of the partials = the partial frequency x the fundamental frequency. I.e. the 3\textsuperscript{rd} partial above A440 is 440 x 3 = 1320Hz

Now, when an interval is played, there are multiple frequencies created above each interval note. These interval notes produce one (or sometimes more) partials that are common to the series of both interval notes. This common partial is referred to as the co-incidental partial. (C.P.) If the frequencies of the C.P.’s are not the same, there will be beating, just like an out-of-tune unison. (See the section on unisons).

WHEN THE FREQUENCIES OF THE CO-INCIDENTAL PARTIALS ARE IDENTICAL, THERE IS NO BEATING AT THE C.P.’S AND THE INTERVAL IS SAID TO BE PURE.

WIDE AND NARROW INTERVALS
Beating intervals (un-pure intervals) are either wide or narrow, depending on which way the notes are out.
- WIDE INTERVAL: Bottom note is flat from pure or top note is sharp from pure.
- NARROW INTERVAL: Bottom note is sharp from pure or top note is flat from pure.
Appendix A – The Harmonic Series and Tone

Every musical note contains a series of frequencies called the Harmonic Series which make up the note’s tone or Timbre. (Tam-ber)
We hear the lowest frequency as the note’s actual pitch. This lowest frequency is called the Fundamental or first partial.
The tone is determined by how much of the higher partials are present in the note.
Think Ewwwww and Eeeeeeee. ‘Eww’ has less high partials in the tone than ‘Eee’.
Your vocal chords have their own harmonic spectrum but the shape of your mouth filters out some of the partials in that spectrum.

The frequencies of the partials in a harmonic series are whole number multiples (1, 2, 3 etc) of the frequency of the fundamental.
Example: A note with a fundamental of 100 Hz has a harmonic series of 100Hz, 200Hz, 300Hz, 400Hz, etc
The actual note names close to those frequencies can be determined by the following chart:

<table>
<thead>
<tr>
<th>Partial Interval above fundamental</th>
<th>When naming notes, we use a system where a number is given to each octave.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>The bottom three notes belong to octave 0, and they are called, A0, A#0, and B0.</td>
</tr>
<tr>
<td>2</td>
<td>The new octaves start at C, so the next note would be C1. (There is no C0).</td>
</tr>
<tr>
<td>3</td>
<td>The top note is C8.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Partial Note</th>
<th>Partial Note</th>
<th>Partial Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 A1</td>
<td>Notice the left</td>
<td>Notice +</td>
</tr>
<tr>
<td>2 A2</td>
<td>Notice the left</td>
<td>Notice +</td>
</tr>
<tr>
<td>3 E2</td>
<td>Notice the left</td>
<td>Notice +</td>
</tr>
<tr>
<td>4 A3</td>
<td>Notice the left</td>
<td>Notice +</td>
</tr>
<tr>
<td>5 C#3</td>
<td>Notice the left</td>
<td>Notice +</td>
</tr>
<tr>
<td>6 E3</td>
<td>Notice the left</td>
<td>Notice +</td>
</tr>
<tr>
<td>7 G3</td>
<td>Notice the left</td>
<td>Notice +</td>
</tr>
<tr>
<td>8 A4</td>
<td>Notice the left</td>
<td>Notice +</td>
</tr>
</tbody>
</table>

***For non-musicians, the pattern is:

Start on any note – count up 12, 7, 5, 4, 3, 3, 2.

<table>
<thead>
<tr>
<th>Start</th>
<th>Up 12</th>
<th>7</th>
<th>5</th>
<th>4</th>
<th>3</th>
<th>3</th>
<th>2</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st Partial</td>
<td>2nd</td>
<td>3rd</td>
<td>4th</td>
<td>5th</td>
<td>6th</td>
<td>7th</td>
<td>8th</td>
</tr>
<tr>
<td>1</td>
<td>A2</td>
<td>E2</td>
<td>A3</td>
<td>C#3</td>
<td>E3</td>
<td>G3</td>
<td>A4</td>
</tr>
</tbody>
</table>
Harmonic Series WORKSHEET

<table>
<thead>
<tr>
<th>Harmonic Series of D1</th>
<th>Harmonic Series of E3</th>
<th>Harmonic Series of F2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Partial Note</td>
<td>Partial Note</td>
<td>Partial Note</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>5</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>6</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>7</td>
<td>7</td>
<td>7</td>
</tr>
<tr>
<td>8</td>
<td>8</td>
<td>8</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Harmonic Series of G#2</th>
<th>Harmonic Series of Db3</th>
<th>Harmonic Series of Ab4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Partial Note</td>
<td>Partial Note</td>
<td>Partial Note</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>5</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>6</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>7</td>
<td>7</td>
<td>7</td>
</tr>
<tr>
<td>8</td>
<td>8</td>
<td>8</td>
</tr>
</tbody>
</table>
## Harmonic Series ANSWER SHEET

<table>
<thead>
<tr>
<th>Harmonic Series of D1</th>
<th>Harmonic Series of E3</th>
<th>Harmonic Series of F2</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Partial</strong></td>
<td><strong>Note</strong></td>
<td><strong>Partial</strong></td>
</tr>
<tr>
<td>1</td>
<td>D1</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>D2</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>A2</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>D3</td>
<td>4</td>
</tr>
<tr>
<td>5</td>
<td>F#3</td>
<td>5</td>
</tr>
<tr>
<td>6</td>
<td>A3</td>
<td>6</td>
</tr>
<tr>
<td>7</td>
<td>C4</td>
<td>7</td>
</tr>
<tr>
<td>8</td>
<td>D4</td>
<td>8</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Harmonic Series of G#2</th>
<th>Harmonic Series of Db3</th>
<th>Harmonic Series of Ab4</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Partial</strong></td>
<td><strong>Note</strong></td>
<td><strong>Partial</strong></td>
</tr>
<tr>
<td>1</td>
<td>G#2</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>G#3</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>D#4</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>G#4</td>
<td>4</td>
</tr>
<tr>
<td>5</td>
<td>B#5(C5)</td>
<td>5</td>
</tr>
<tr>
<td>6</td>
<td>D#</td>
<td>6</td>
</tr>
<tr>
<td>7</td>
<td>F#5</td>
<td>7</td>
</tr>
<tr>
<td>8</td>
<td>G#5</td>
<td>8</td>
</tr>
</tbody>
</table>
Appendix F – Equal Temperament

Remember from our discussion in Chapter 1.3 Pure, Wide, and Narrow Intervals, that we can produce a pure fifth above any note by multiplying the frequency of the bottom note by 1.5 (and this pure fifth will not be beating). Also I suggest that from an aesthetic point of view, pure intervals, in most cases, are the most pleasing to hear, ideally, and therefore preferred, especially in groups of instruments with flexible pitch control like choirs, wind orchestras, etc.

Also, understand that we can produce an ideal octave by multiplying a bottom note’s frequency by 2.

By using these two factors (pure fifth = 1.5 and octave = 2) we can demonstrate an interesting problem with the physics of music. I am going to show that it is impossible to go from one note to another by producing pure intervals in two different ways. i.e. the intervals don’t fit or work out! (The small discrepancy in final frequency when going from one note to another by pure intervals in two different ways, is called a musical comma. There are different commas depending on what two ways you use. See the end of this appendix for different examples)

Starting at A440 and multiplying by 2, we can get a frequency of A0 to start with.

A4 = 440Hz
A3 = 220
A2 = 110
A1 = 55
A0 = 27.5

Now starting at A0 approximately 27.5Hz, and using a factor of 2, we can calculate the ideal octave frequencies of all the A’s.

A0 = 27.5Hz
A1 = 55
A2 = 110
A3 = 220
A4 = 440
A5 = 880
A6 = 1760
A7 = 3520 (Note this frequency created by pure octaves from A0)

(Now, to understand this next procedure, you need to understand the Cycle of Fifths. If you are not familiar with this, please see Appendix G - Cycle of Fifths.)
We can also get from A0 to A7 by creating pure fifths using the factor 1.5. This will produce musically pleasing pure fifths. Here we go, starting at A0 (27.5Hz), frequencies to one decimal place.

<table>
<thead>
<tr>
<th>Note</th>
<th>Frequency (Hz)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A0</td>
<td>27.5</td>
</tr>
<tr>
<td>E1</td>
<td>41.2</td>
</tr>
<tr>
<td>B1</td>
<td>61.9</td>
</tr>
<tr>
<td>F#2</td>
<td>92.8</td>
</tr>
<tr>
<td>C#3/Db3</td>
<td>139.2</td>
</tr>
<tr>
<td>Ab3</td>
<td>208.8</td>
</tr>
<tr>
<td>Eb4</td>
<td>313.2</td>
</tr>
<tr>
<td>Bb4</td>
<td>469.9</td>
</tr>
<tr>
<td>F5</td>
<td>704.8</td>
</tr>
<tr>
<td>C6</td>
<td>1057</td>
</tr>
<tr>
<td>G6</td>
<td>1586</td>
</tr>
<tr>
<td>D7</td>
<td>2379</td>
</tr>
<tr>
<td>A7</td>
<td>3568</td>
</tr>
</tbody>
</table>

PURE FIFTHS ABOVE A0(27.5Hz) PRODUCE A7 = 3568Hz, WHICH IS MUCH HIGHER THAN THE A7 = 3520Hz PRODUCED BY PURE OCTAVES ABOVE A0.

PURE OCTAVES FROM A0 → A7 = 3520Hz
PURE FIFTHS FROM A0 → A7 = 3568Hz

(If this is the first time you have been exposed to this, you might want to take a break and re-evaluate the meaning of life.)

Musically speaking, the pure octaves are more important to preserve, so the only option to fit the fifths into the octaves smoothly, is to shrink (narrow) all the fifths by an equal amount. I.e. temper all the fifths

This how the Equal Tempered Tuning System is created. The benefit of this system is that we can play in all twelve keys and each key will not sound more or less out-of-tune than any other key.
Appendix G - Cycle of Fifths

Intervals

It is beyond this text and course to teach and explain the theory of musical intervals. Having said that, if you are not familiar with the cycle of fifths, you will need some temporary theory to deal with this until you work on this yourself, to memorize and know intimately all the keys and their intervals.

Common intervals in the key of C (no sharps/flats) and the number of semitones (keys) that they are above C, NOT including C. If you are not fluent in music interval theory, you can always count the keys to figure out each interval, no matter which note you are starting on.

<table>
<thead>
<tr>
<th>Notes</th>
<th>Interval Name</th>
<th># of Keys above C</th>
</tr>
</thead>
<tbody>
<tr>
<td>C C</td>
<td>Perfect Unison, PU</td>
<td>0</td>
</tr>
<tr>
<td>C Db</td>
<td>Minor Second, min2, m2</td>
<td>1</td>
</tr>
<tr>
<td>C D</td>
<td>Major Second, Maj2, M2</td>
<td>2</td>
</tr>
<tr>
<td>C Eb</td>
<td>Minor 3rd, min3, m3</td>
<td>3</td>
</tr>
<tr>
<td>C E</td>
<td>Major 3rd, Maj3, M3</td>
<td>4</td>
</tr>
<tr>
<td>C F</td>
<td>Perfect Fourth, P4</td>
<td>5</td>
</tr>
<tr>
<td>C Gb</td>
<td>Diminished Fifth, dim5</td>
<td>6</td>
</tr>
<tr>
<td>C G</td>
<td>Perfect Fifth, P5</td>
<td>7</td>
</tr>
<tr>
<td>C Ab</td>
<td>Minor Sixth, min6, m6</td>
<td>8</td>
</tr>
<tr>
<td>C A</td>
<td>Major Sixth, Maj6, M6</td>
<td>9</td>
</tr>
<tr>
<td>C Bb</td>
<td>Minor Seventh, min7, m7</td>
<td>10</td>
</tr>
<tr>
<td>C B</td>
<td>Major Seventh, Maj7, M7</td>
<td>11</td>
</tr>
<tr>
<td>C C</td>
<td>Perfect Octave, P8</td>
<td>12</td>
</tr>
</tbody>
</table>

Cycle of Fifths

The Cycle of Fifths is an extremely useful tool for musicians for composing, practicing, improvising, etc and is a requirement to memorize in order to know music theory better.

The property of the Cycle of Fifths that makes it so useful is that, starting on any note, you can build 12 perfect fifths above the starting note and you will be back where you started, having produced all 12 notes in western music.

Example:

A – E – B – F# - C#/Db - Ab - Eb – Bb – F – C – G – D – A
Cycle of Fourths

Similarly, the Cycle of Fourths has the same characteristics, and is just the Cycle of Fifths in reverse.

A – D – G – C – F – Bb – Eb – Ab – Db/C# - F# - B – E – A

Some Important Concepts to Understand as the Cycle of Fifths Relates to Piano Tuning.

The Cycle of Fifths/Fourths can be used to memorize an order of notes to tune within the temperament octave F3F4.

Please understand that the Cycle of Fifths produces note names that are perfect fifths above each successive note in the order, but in order to keep the notes within F3F4, the actual note may have to be brought down the octave. This of course produces a musical perfect fourth if you were to look at it as a musician sees intervals. Please don’t get confused. It is still the Cycle of Fifths. A perfect fifth above a note produces the same note name as a perfect fourth below the same note.
Appendix L – Basic Tuning Procedure

1) Mute the piano
   b) Upright - Strip mute from highest trichord before treble, down to first bichord.
      - Put a wedge mute on the first trichord if needed. (Note: if there is an odd number of bi-
        chords to the right of the tenor break, you will not need a wedge mute here.)
      - Put the Papp’s mute on the last trichord before the treble break.
   c) Grand Piano - Strip mute from the highest C down to the first bichord
      - Jump from the far side of the dampers to the near side when there is room for the strip on
        the near side.
      - Put wedge mutes in the notes on the ends of each section so that only one string segment
        is free to vibrate.

2) Tune A4 to the fork  Tune A3 to A4
3) Tune the temperament octave, usually F3 to F4
4) Tune F#4 up to high C (C8) using octaves and other checks. (Uprights – in the treble sec-
   tion, you will need to start using the Papp’s mute and start tuning unisons as you go.)
5) Tune from E3 to the first note, A0, using octaves and other checks. (Tune the unison on the
   first bichord as you pass it, if the last unichord was muted.) (Notice the pattern in the tuning
   pins. This helps speed tuning.)
6) Starting at the first note to the right of the tenor break, pull out the strip mute (and wedge if
   used) up to the first trichord.
7) Tune the unisons that have been revealed and continue up. Grand Piano – pull out the
   wedges as needed and use them to help isolate unisons. Upright Piano – the treble section
   has already been tuned with the Papp’s mute.
8) Pull out the strip mute in the bichord bass section and tune the unisons revealed. Notice
   the pattern of tuning pins needed. This helps speed tuning time.
9) Now the first pass is done. Check all the unisons again. (It is a good idea to play all the
   notes loudly before this unison check to test stability.) Start in the treble. Use melodic
   checks in the highest treble. Check two notes of a unison at a time. Move a wedge from
   note to note and use a pattern of outside unisons/inside unisons to reduce the number of
   times you have to move the mute.
10) Now check octaves and fifths from C3 to C8 using a chord approach. All keys, bottom note
     from C3 to C4.

   Bar 1 – Listen for in tune unisons
   Bar 2 – Listen for in tune intervals
   Bar 3 and 4 – Listen for in tune octaves that have in tune unisons that are also in tune with the
                  left hand

11) Play a test piece. Criteria: Slow - to allow out of tune notes to be heard. Melody that uses a
    lot of different notes, or change the key of the song as you play. Change the octave of the
    melody and accompaniment to test all areas of the piano. Use wide chords and intervals.
Appendix P

Mark Cerisano's Temperament Notation

Diamond note = Already tuned
Regular note = Note to tune
Square note high = Coincidental Partial
Square note low = Check Note

Tune from fork
Match beats

Set to approx. 7bps

Top >

Lower Skeleton.
M3’s beat evenly
>, >>, <, << or =

Upper Skeleton.
Retune F4 so M3’s are increasing evenly

Retune F3 if needed

Check all M3’s even and >

If this doesn’t fit you may need to recheck your 8ves

The White Anchor

This should fit

Black Anchor

4ths do not equal
M3 G3B3

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Appendix Z – Octave Templates

OCTAVE TEMPLATE SHEETS – USE THESE TO HELP YOU VISUALIZE THE DIFFERENT OCTAVE SIZES AND THE OUT-OF-TUNENESS OF THE PARTIALS.

1) Place A3 (this sheet) on top of A2 (the other sheet)
2) Line up A2 Partial 2 over A3 Partial 1. This is the size of a 2:1 octave. Notice how out of tune the 8:4 partials are.
3) Line up A2 Partial 8 over A3 partial 4. This is an 8:4 octave. Notice how out of tune the 2:1 partials are.
4) The optimum size for most octaves, except the low bass, is that which compromises the out of tune partials. Place A2 Partial 4 over and slightly to the left of A3 partial 2, so that A2 Partial 6 is slightly to the right of A3 partial 3. All the partials pairs are now only slightly out of tune.

So, we say the optimum size for this octave is slightly larger than a 4:2 octave and slightly smaller than a 6:3 octave.
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