Aural Piano Tuning Theory
Chapter 1 - Basic Music Theory
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INTRODUCTION

This is the first article in a series of articles that will discuss the theory of piano tuning. It is quite possible to tune a piano with only a basic understanding of piano tuning theory, but the more one knows about the theory of piano tuning, the easier they can understand the "why" of what they are doing. Often, a beginner is given piano tuning instructions and they are expected to execute these instructions without a complete understanding of the "why". Why do we use F2 to tune A4 to the fork? Why do we tune fourths wide and fifths narrow? Why do we set check notes flat? Why and when do we tune mid-range octaves as pure or wide 4:2 octaves? And just what is a 4:2 octave anyway?

As we discuss different theory topics that relate to piano tuning, there will be topics that could be expanded, but for the purpose of this discussion, we will keep the extent of theory in each topic to a minimum - only discussing the issues that relate directly to the task of tuning a piano.

With the advent of Electronic Tuning Devices, (ETD's), it may appear at first that the technician does not need to know as much piano tuning theory as does the aural piano tuner, but that could not be further from the truth. In fact, it could be said that to use an ETD effectively, one might even have to know more theory than does the strictly aural tuner (aural meaning "to tune by ear"). For example, how and when should I set the stretch to pure P19's? And just what is a P19 anyway?

NOTE NOMENCLATURE

The term "nomenclature" means "a system or set of terms or symbols especially in a particular science, discipline, or art."
(source: https://www.merriam-webster.com/dictionary/nomenclature)

Music theory is a large subject. There are many rules and many ways of naming notes and reasons why they are named different ways. However, for the purpose of naming notes in the field of piano tuning, many texts use a system of naming notes that can provide some confusion, especially if the reader has a strong music theory background.

The source of this confusion comes from the following distinction between music theory for musicians and music theory for piano tuners:

Musicians need an elaborate system of note naming in order to allow for the many different combinations of notes that occur in different keys, chords, and scales, etc.

Piano tuners however, only need to know which note to tune in what order. That's it. They are not composing nor arranging music. They are not improvising. They are not transposing or transcribing music.

To repeat, in the process of tuning a piano, a piano tuner only needs to know which keys to tune and in what order. For this purpose, all we need is to give each key a name and then the tuner just tunes that key.

We could have just named each key a number, from 1 to 88 for example. But what has happened over the years is that one system we have arrived at, and the one we will use in these series of articles, is the following system for naming each note:

"Each piano key is named by the letter of that key. If the key is a sharp or flat, we only use the sharp to name it. No flats are used in piano tuning theory."

We could have just listed this rule at the beginning of the article, but it is important to understand why we use this system because in using it, it creates some naming situations that are just plain wrong in the classic music theory point of view. If you can separate out these two naming systems now, it will reduce confusion later on.

So, when naming notes within an octave from C to C for example, we would name them as:

C - C# - D - E - F - F# - G - G# - A - A# - B - C

OCTAVES

But there are eight different C's in the full sized piano. How do we know in which octave is a note? There are a few systems for that. One is to give the key number to each note so that notes are named, starting at the lowest A, like this:

A1 - A#2 - B3 - C4 - etc.

Common notes in this system would be A49 (often tuned first in aural systems), F33 and F45 (the octave that is often tuned first aurally, called the temperament octave), and C40 (middle C).

However, the most common system of naming octaves is to start with octave 0 to denote the notes below the first C, and then change the octave number at each C. In this system, the notes are named as such:

A0 - A#0 - B0 - C1 - C#1 - D1 - D#1 - ……….. - A7 - A#7 - B7 - C8

Common notes in this system are A4, (often tuned first in aural systems), F3 and F4 (the octave that is often tuned first aurally, called the temperament octave), and C4 (middle C).

Now that we have a system for naming each key on the piano, we can move on to talking about intervals.

INTERVALS

Often when discussing what notes to tune and when, we need to describe the distance between two notes. In standard music theory, this distance between two notes is called an interval.

The standard or classical (these two terms will be used interchangeably in this article) theory system for naming music intervals is quite complicated, and is very useful when performing and writing music. But since piano tuning theory is merely needed to describe the process of what notes to tune and in what order, the standard music theory system is not needed. In fact, all we really need to know when describing the distance between two notes, also described as the number of keys there are between two notes, is the number of keys between those two notes.

If piano tuners were completely unmusical, we might just name intervals by the number of keys between two notes. For example, C1 to C2 would be called a 12th (There are 12 keys from C1 to C2). But because most piano tuners have at least some musical background, the standard system has been somewhat adopted, but with a few problems.

STANDARD MUSIC THEORY

To name intervals in the standard way, we need to know about major scales because the name of the interval comes from the notes of the major scale above the bottom interval note.

The number comes from the letters between the interval notes, including each note. So, C1 to F1 would be a fourth. (C - D - E - F) The key of C has no sharps and flats. (Another rule in naming major scales in standard music theory is to name each letter in the scale once and only once.)

The quality of the interval is a name added to the number. Examples: Major, Minor, Augmented, and Diminished.

The quality of all intervals above a note, where the top note belongs in the major scale built upon the bottom, note is given by the following table:

Unisons (the same note, no notes between) are called Perfect Unisons (PU)
2nds are called Major Seconds (M2)
3rds are called Major Thirds (M3)
4ths are called Perfect Fourths (P4)
5ths are called Perfect Fifths (P5)
6ths are called Major Sixths (M6)
7ths are called Major Sevenths (M7)
Octaves (8 letter names apart) are called Perfect Octaves (P8)

So, looking at this table above, it would be easy enough to name these intervals above C, in the key of C with no sharps or flats, but when we start adding other keys that have sharps and flats in the major scale and adding upper interval notes that are not in the major scale of the bottom interval note, things quickly get very complicated.

If the reader is interested in musical composition, arranging, improvising, or even just sight reading, they are well advised to study the classical music theory system until it is second nature and they know it as well as they know the alphabet.

SIMPLIFIED INTERVAL THEORY FOR PIANO TUNERS

However, when discussing piano tuning, we just want to know how many keys to go up or down from one note to another.

For this reason, the following table accurately describes the names and sizes of intervals commonly used by piano tuners when discussing piano tuning theory:

PU (Perfect Unison) = no keys
m2 (Minor Second) = 1 key
M2 (Major Second) = 2 keys
m3 (Minor Third) = 3 keys
M3 (Major Third) = 4 keys
P4 (Perfect Fourth) = 5 keys
d5 (Diminished Fifth) = 6 keys
P5 (Perfect Fifth) = 7 keys
m6 (Minor Sixth) = 8 keys
M6 (Majr Sixth) = 9 keys
m7 (Minor Seventh) = 10 keys
M7 (Major Seventh) = 11 keys
P8 (Perfect Octave) = 12 keys

These are the "names" of the intervals. We could have just used names like "5 keys" and "8 keys" saying things like "Go up 5 keys" or "Go down 8 keys" but as has been said, many tuners are musicians and still like to use the musical names.

PROBLEMS WITH THESE INTERVALS AND NOTE NAMES

One of the main reasons we use these interval names is that when you tell a musician to go up a P4 from F3, for example, they "see" in their mind the picture in figure 1.

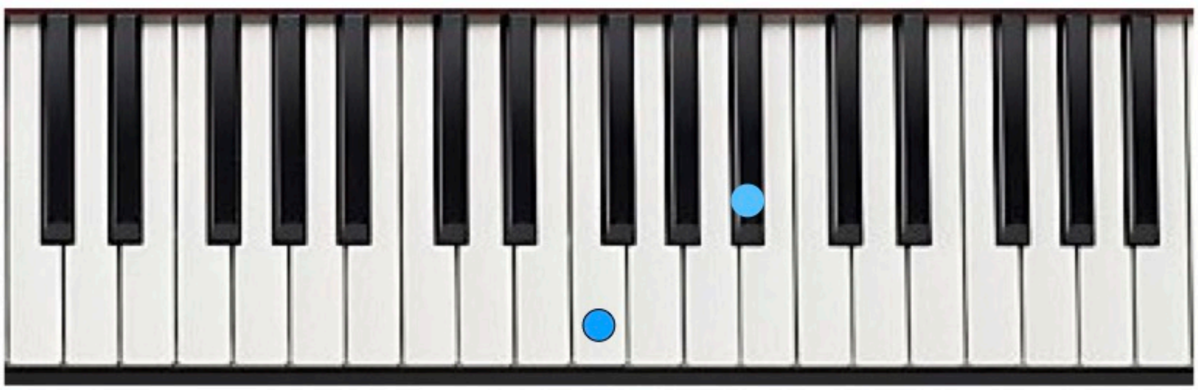


Figure 1. A P4 Above F3

We can "see" that when we count up 5 keys (as describes the P4 in the above table) from F, we get to that black key between A and B. But what is the name of that black key? Piano tuning theory dictates that the name of that black key is A# (no flats are used in piano tuning theory).

But how many letters are there between F and A#?

F - G - A

There are three letters between F and A. The interval shown in figure 1, when the notes are named using piano tuning theory, is technically NOT a fourth, but actually a third, when using the standard music theory system.

Technically speaking, from a classical music theory perspective, F to A# is an Augmented Third, and a P4 above F is Bb, because F to B is four letters, (F - G - A - B) and B is flat in the key of F major.

Do you see the problem? Some classically trained musicians find this system very difficult to understand, because they don't understand that piano tuners just want to know which key to press and how many keys up or down to go to tune the next note. They are tuning a piano, not improvising or composing or arranging music. It would have been easier in some ways if early piano tuners used only numbers for the note names and intervals, numbers that had no reference to the classical music theory system.

But it is what it is. We won't be using flats any time soon in standard piano tuning theory discussions and the intervals won't be completely agreeing with the classically named intervals anytime soon either, so the sooner a piano tuning student understands this; the better. Understand that we name notes and intervals in piano tuning theory so that each note has one and only one name, and each distance between two notes (the interval) has one and only one name for each number of keys or notes.

AN EASY WAY TO NAME INTERVALS

There is an easy way to name intervals using this graphical tool that you can make yourself.

Use a graphics program and make the following drawings in the program. Format the page to be landscape at 8 1/2" high by 11" wide.

1) Draw a "keyboard" made of 88 rectangles. Make each rectangle the same size. You can name a few of the keys as well. See figure 2.

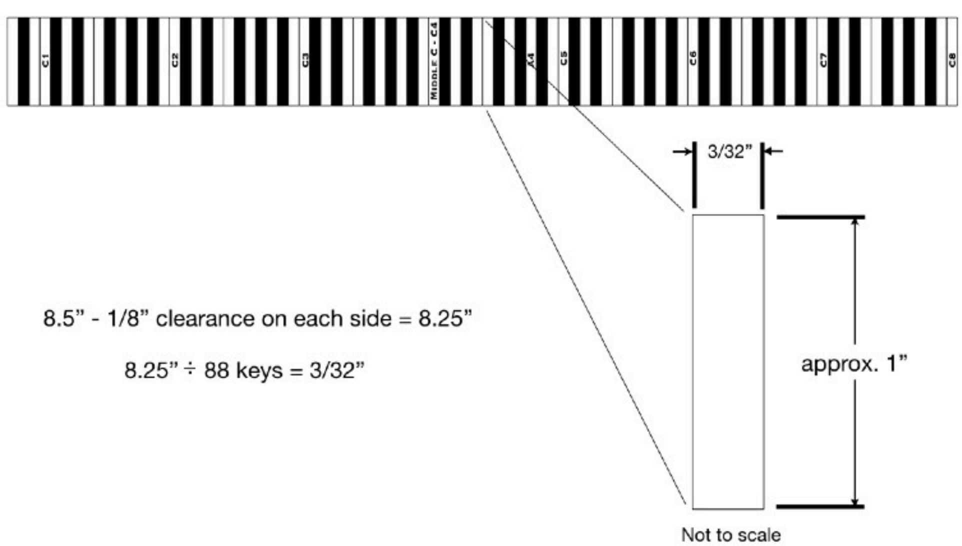
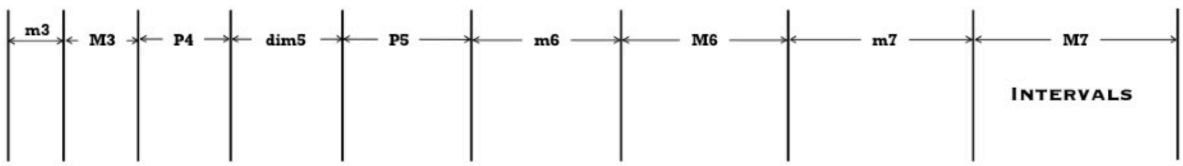


Figure 2. Dimensions for Graphical Keyboard

2) Draw a set of vertical lines which will be called the Interval Slide, so that they are set apart from each other by the distances shown in figure 3.



INTERVAL	# OF KEYS	DISTANCE
m3	3	1/8”
M3	4	5/32”
P4	5	3/16”
d5	6	7/32”
P5	7	1/4”
m6	8	9/32”
M6	9	5/16”
m7	10	11/32”
M7	11	3/8”

Figure 3. Dimensions for the Interval Slide

3) Print the page and cut out the keyboard and the interval slide. The paper in figure 4 has been laminated.

Figure 4. The Interval Slide and the Keyboard

4) Slide the interval slide above and behind the keyboard until the interval you want to figure out is shown. See figure 5.

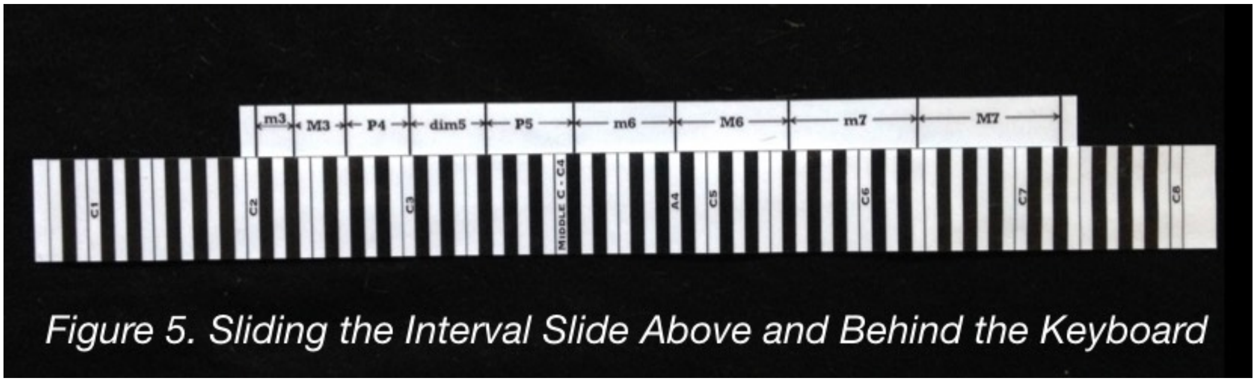


Figure 5. Sliding the Interval Slide Above and Behind the Keyboard

Now it is incredibly easy to name any interval note above or below any note.

Example 1. A perfect fifth above G#3:

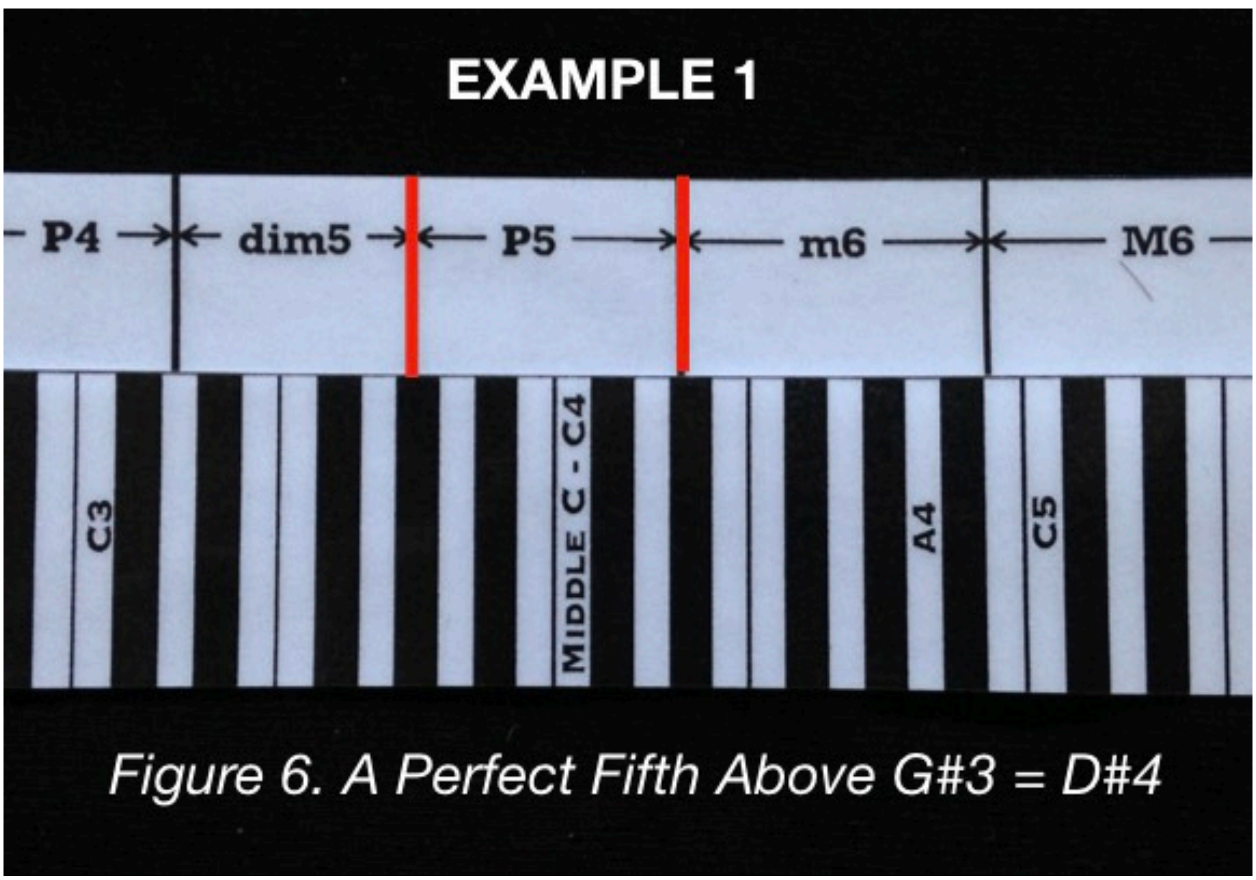


Figure 6. A Perfect Fifth Above G#3 = D#4

Example 2. A M6 below C4

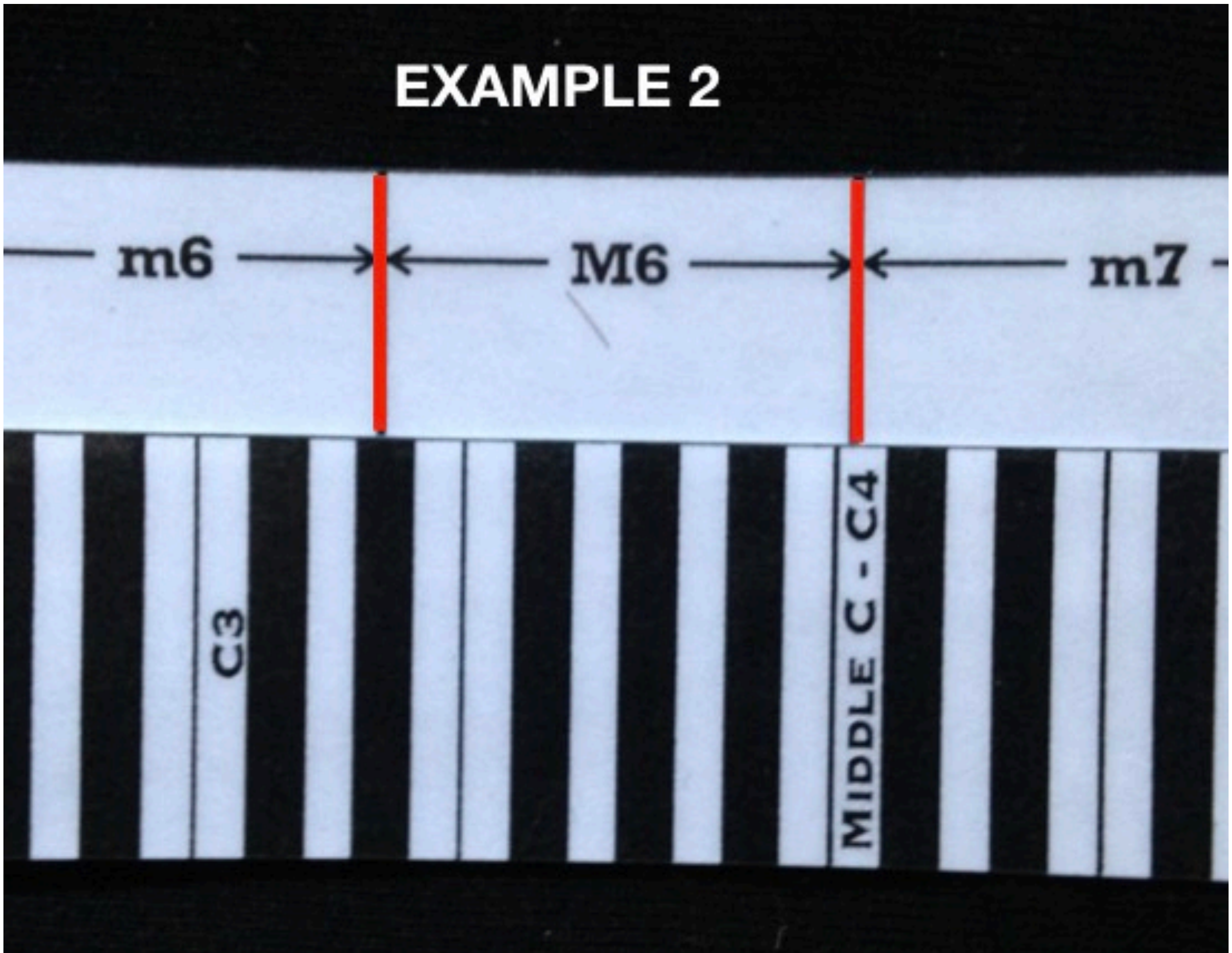


Figure 7. A Major Sixth Below C4 = D#3

Example 3. A diminished fifth below A#5

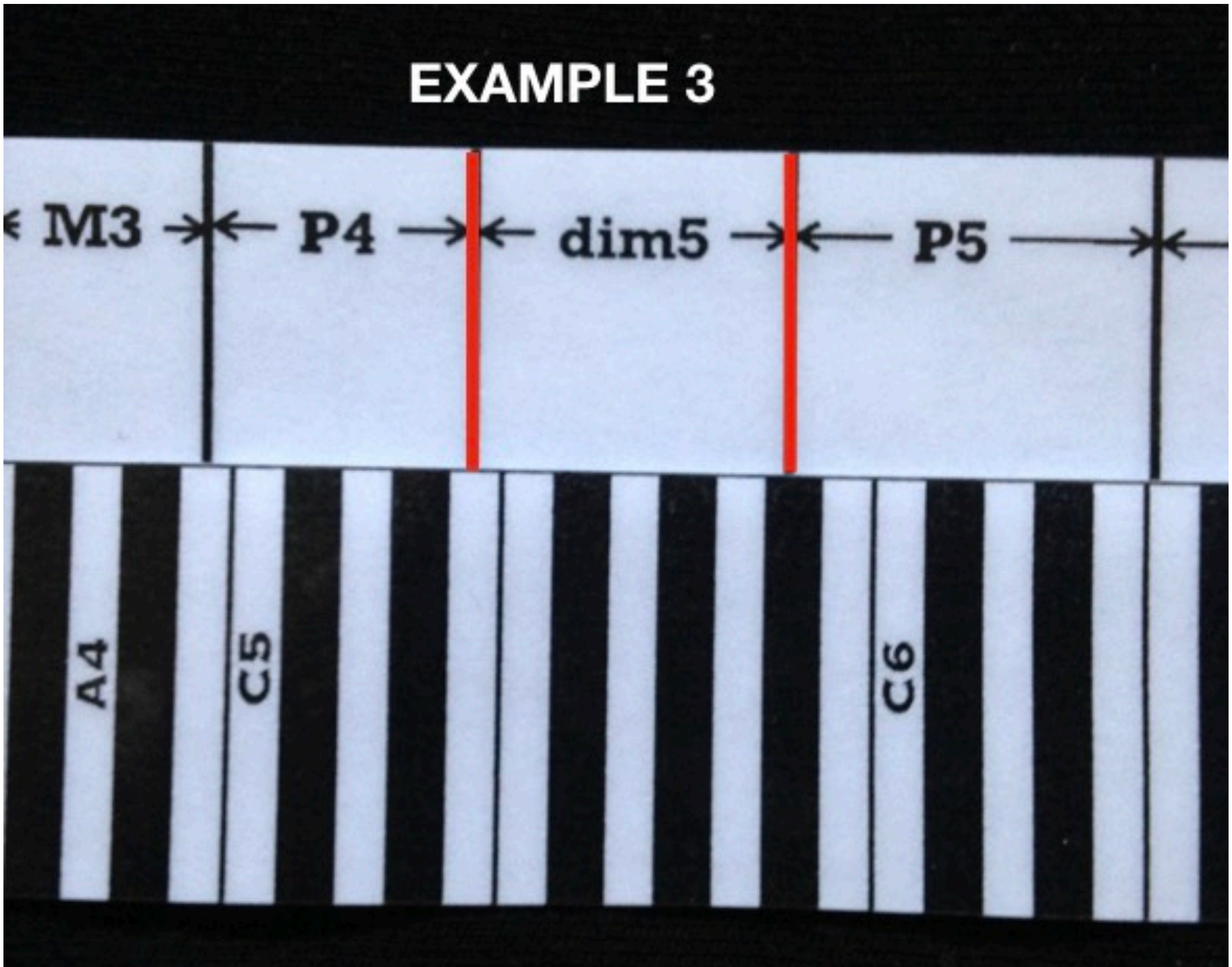


Figure 8. A Diminished Fifth Below A#5 = E5

It needs to be repeated that some of the intervals above are not named correctly according to standard music theory. It is hoped that the reader can see the benefit of simplifying the note and interval naming system for the purpose of having everyone, even those with minimal music theory background, be able to quickly name and discuss notes and intervals when discussing piano tuning theory.

CONCLUSION

In this article we talked about the difference between naming notes and naming intervals using the classical music theory system and a simplified standard piano tuning theory method and the reasons for each.

We also talked about a graphical method of displaying intervals that allows a person to quickly and easily name a given interval above or below any given note.

If the reader would like to use an already created PDF that they can just print out and start using, they can go to http://howtotunepianos.com/media-for-piano-tuning-theory-article/ and download a PDF that they can print out as is and cut up so that they can quickly and easily name any interval.

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