



## Is My Piano In Tune?

*by Rob Mitchell*

In previous articles, I've talked about the mechanisms that cause pianos to go out of tune and the fundamentals of temperaments and octave stretch. For this issue, I'll get back to basics in regards to the ways pianos can be out of tune and how technicians tune them.

### Terminology

First though a refresher on some terminology. In the key-naming scheme used widely by technicians, the entire keyboard is divided into numbered octaves 1 through 8, each octave extending from C up to the next B. Since we have a few extra notes below the lowest-C on the left, these have been designated octave 0. Starting with the lowest A these are in sequence: A0 A#0 B0 C1 C#1 D1 and so forth. Middle-C in this scheme is C4 and high-C is C8 (the only note in this octave).

"Cents" are a piano technician's way of characterizing how far a single note or an entire piano is out of tune. Rather than measure the frequency error of a note, it is far more convenient and relevant to state the error as sort of a percentage. Simply put, there are 100 cents between any two adjacent keys (half-steps, e.g. A4 and A#4) anywhere in the piano.

The other important preliminary point is the string layout inside pianos (what piano manufacturers call the "Scale Design"). If you've never looked closely inside a piano, you might assume, "one note, one string". But in reality there is only one string per note for the very lowest notes in the piano (sometimes referred to as monochords). Moving up in pitch most pianos will switch to two strings per note (bichords) somewhere around G1. Then usually around B2, you will start to see three strings per note (trichords). The actual point where these transitions occur will vary with different piano manufacturers and the various sizes of pianos.

When tuning the two or three string notes, technicians will talk about "tuning the unisons" since the pitch of each string must match the others exactly (or be in unison). More on this later.

For this article, I'll break down the ways that a piano can be out of tune, simple ways for the piano player to test whether a piano is in tune, and how technicians go through the tuning process.

### Being "Out Of Tune"

The three basic ways that pianos can be out of tune are:

1. Absolute pitch error
2. Relative note-to-note pitch errors
3. Unisons out of tune

Of course, when pianos go out of tune, it's usually all three components.

By international agreement, the universal pitch standard is for A4 (the A above middle C) to be tuned to 440Hz. Some musical institutions (conservatories, schools, performance halls) prefer to tune to 441Hz or even 442Hz. But by far, 440Hz is the most common and accepted standard.

Generally, the longer a piano goes without tuning, the flatter in pitch it will go. It's not uncommon to see pianos over 100 cents flat that haven't been tuned in a few years. This would mean A4 is somewhere below 415Hz.

If relative pitch were maintained, then going flat or sharp overall would not be too terrible of a thing. Playing the piano would sound fine and only someone with perfect pitch would be offended. Regrettably, this is definitely not the case. As pianos stray from their target pitch, the pitch of various notes move in a "non-linear" way to different degrees (depending on their string length, composition and position relative to the bridges and struts). As such, most of the intervals and chords will now sound "off". This can be anything from a fairly subtle "sourness" in the intervals to more drastic problems. Although it is easy to accurately tune a piano to a pitch other than 440Hz, it would be virtually impossible for a piano to "drift" to another pitch but still stay in relative tune.

The final way that a piano could be out of tune is for the unisons to be off. As you can imagine, if you're going to strike a key that has three strings, then the pitch of those strings must be very nearly identical for a single, pure tone to emerge. Unisons that are slightly out of tune may have a slow rolling beat or sound vaguely "watery". Unisons further out tune may have a more pronounced beat or can produce the "honky-tonk" piano sound. As the pitch of a piano drifts, both the relative pitch of notes and unisons will tend to go out of tune.

### Testing a Piano

Here are two tests that anyone can use to see whether their piano is in tune:

- Play *every* note, one at a time by itself to test the unison. The note should sound clean and pure without any beat, roll or vibrato.
- Play ascending double octaves. Starting in the bass, play C1 and C3 at the same time and you should hear either a pure overall tone or a very slight beat (roll). Then play C#1 and C#3 together. Repeat this pattern all the way into the treble.

Although you won't know if absolute pitch is correct using these, you will get a quick sense of whether the piano is in tune.

### Tuning a Piano

The history of piano tuning has obviously been around for as long as pianos have. In the early years, it was quite common for pianists to tune their own pianos -- before this became a specialized trade. And for almost as long, piano technicians have relied on their ears to tune pianos. Through a process that involves making adjustments based on the relative beat rates of different intervals, the tuner is able to set all of the notes in one octave (usually in the midrange) to the correct pitches. After the notes in the midrange octave are set, the pitches are then "copied" to adjacent higher and lower octaves until the entire piano is tuned. People sometimes comment that a technician must have a good sense of pitch to aurally tune a piano. Surprisingly, a good sense of rhythm is more important in this activity.

Around 40 years ago, Electronic Tuning Devices (ETDs) emerged as a new way to tune pianos. Although the early models were crude by today's standards, current devices can do an excellent job setting the pitch for individual notes.

Within the piano technician community, it is generally agreed that someone using a state-of-the-art ETD can do an excellent job of tuning a piano. Head-to-head competitions between the best aural tuners and pianos tuned by ETD have produced results that are indistinguishable from each other as judged by the experts. ETDs are also generally thought to be faster than all but the most experienced aural tuners and can in fact do a better job in two specific situations: very noisy environments (like a concert stage) or on pianos that are very sharp or flat. For the latter case, ETDs have a unique ability to compensate for the change in overall plate tension caused by dramatically changing a piano's pitch, and can frequently get the tuning correct in a single pass (if the pitch isn't too far off).

Even when using an ETD, most technicians like to aurally check various intervals as they go. So for example when I'm tuning, I'll usually check octaves, fourths and fifths to be sure everything sounds okay and the beat rates are correct.

Whether a piano is tuned using an ETD or by ear, the unisons are always tuned aurally. So, even though a technician looks to be using an electronic tuner, they are using their ears for all of the unison tuning (and hopefully much more). For the bichords and trichords, it's first necessary to tune one of the strings to the correct pitch. This is followed by tuning the balance of the strings in the unison to the leading string. Most technicians prefer to "tune the unisons as you go", though this is not universal.

Tuning the unisons on some pianos presents unique challenges if the strings are very hard to render (this is the process of matching the tensions in the different segments of the string as best as possible). For these pianos, a technician may inadvertently leave a tension imbalance in a string that can slip later during forceful playing of the piano. In this way, a unison can "pop out" soon after tuning even though everything else is okay. All piano technicians work very hard to avoid this condition, but it can happen to the best. Let your technician know if happens soon after a tuning -- most reputable technicians will revisit to correct the problem.

Tuning good, stable unisons is arguably one of the most important skills a piano technician needs. Problems with the unisons will almost always be immediately apparent to the pianist. To get the best unisons, technicians use the hammer techniques they have developed over the years along with strong test blows to "set the pin". Ever wondered why your piano technician seems to play the notes so hard while tuning? Because this helps to equalize the string tensions and they would rather a problem show up while tuning, not later when the pianist is playing.

My objective when tuning a piano is to deliver the best possible tuning using the all tools I have available to me. As such, I use one of the top electronic tuners on the market combined with many aural checks and what I believe to be a very good hammer technique. When someone asks if I tune aurally or electronically, I very sincerely answer, "both". (I can aurally tune an entire piano for those that are interested).

For more information or to request an appointment, visit [www.mitchellpianoservice.com](http://www.mitchellpianoservice.com).