

## The Hybrid Piano: What Goes Around Comes Around

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### Introduction: Computers + Pianos

We have all been watching as our daily lives increasingly depend on support from electronic devices that in turn are based on digital computing technologies. For example, we use computers at home for business and social purposes, we use cell phones extensively, and our cars are dependent on multiple embedded computers. So we are not surprised that technology has invaded the piano world. Since 2009 a new type of piano, the **Hybrid Piano**, has been sold in piano stores, along with the traditional acoustic piano and the simpler electronic and digital pianos and keyboards. Figure 1 shows an example of one.



*Figure 1: Yamaha N3X Grand Hybrid Piano*

The version of hybrid piano addressed in this article has a software-based digital computer foundation, and mechanically has an action and trap work designed to achieve the exact same tactile characteristics as a traditional acoustic piano. It has no vibrating strings so is sometimes also referred to as a digital hybrid piano, and the output sound quality is adjusted by the pianist to correspond to a selected traditional piano model, ranging from a spinet to a concert grand, as

well as other instruments such as an organ or a harpsichord. Some of the tactile characteristics of both keys and pedals are also selectable.

Bottom line: the hybrid piano attempts to 100% imitate the acoustic piano experience, while offering the musician additional features not available with the traditional piano.

### **Unique to the Hybrid Piano**

The particular focus of this article is on some of the hybrid piano's unique characteristics dealing with musical expression and tuning temperament, and in general to help the reader further understand how computers are used to enhance the functionality of the piano. While piano tuners like myself tune the traditional acoustic piano in a modern standardized Equal Temperament (ET), or a variant of ET, this article also describes how the hybrid piano (along with some earlier digital pianos) alters the tuning environment and brings it more directly under the control of the pianist.

### **A Return to the Music Expression of Chopin and Beethoven**

The Hybrid Piano gives pianists control over the *temperament* used to tune them, an ability to match the composer's intent that has not been commonly available to the piano-playing public, or commonly understood in keyboard instrument circles, for over 100 years. It provides the pianist or composer immediate touch screen access to the many variations offered by historic tuning temperaments, such as Meantone, Just Intonation, Well Temperament, and more. Such historic temperaments were in common use during the time of classic composers such as Bach, Mozart, Schubert, Tchaikovsky, etc.

### **Examples of Expression**

Why did Chopin choose the key of B Flat Minor in which to compose his "Funeral March" that is shown in Figure 2? Because that key, when a piano is tuned in the appropriate historic manner, was known to be surly with an unpleasant countenance. Similarly, why did Beethoven choose C Sharp Minor in which to write his Moonlight Sonata, as again shown in Figure 2? Because that key was known to convey despair, wailing, and weeping. But as will be explained, modern acoustic piano tuning has by design and necessity eliminated this musical key signature contribution to musical expression, regardless of what a few musicians might say otherwise. With the modern ET tunings each of these two musical pieces can be transposed from their original minor key to any other minor key, and when played in the new minor key the piece will sound exactly the same – a mathematical and physical certainty of Equal Temperament!

### **What Goes Around Comes Around**

To once again have available, on a musical piece-by-piece basis, a piano, which can be instantly tuned with what are now called "historic temperaments," is a very exciting development. As indicated with the two key signature examples given in Figure 2, there is a distinct difference in

sound, expression, and mood when a piece is played in the original musical key and temperament for which it is intended.

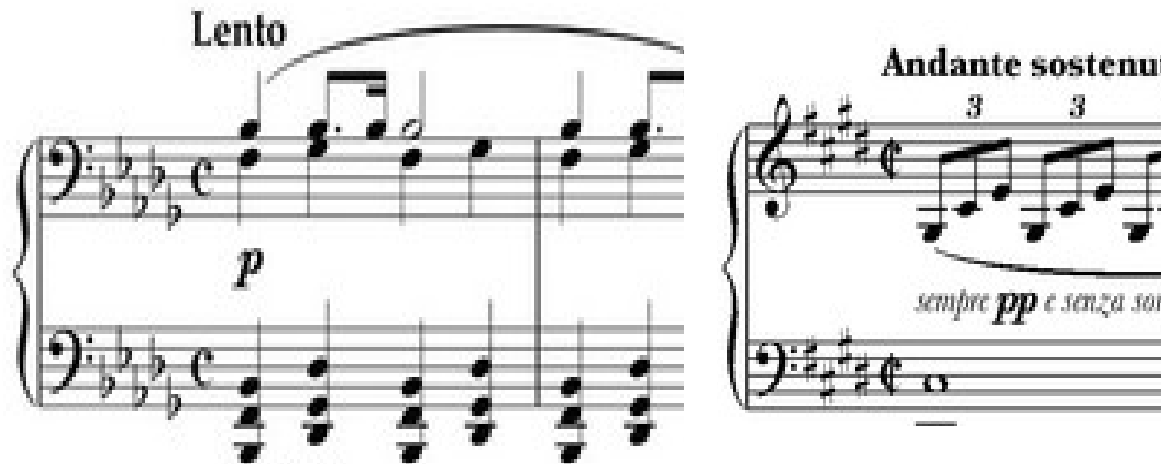


Figure 2: Two Musical Key Signatures. On the left, B Flat Minor for Chopin's Funeral March, and on the right C Sharp Minor for Beethoven's Moonlight Sonata.

And not to be overlooked, the hybrid piano offers modern-day composers the opportunity once again to choose a musical key signature that will evoke the degree and type of musical expression that they desire.

### Historic Temperaments

A “**Temperament**” is a tuning system that slightly compromises the pure intervals of just (i.e., pure) intonation to meet other requirements. Particularly the requirements with a fixed keyboard instruments, like a piano, to figure out what frequencies to set the twelve notes per octave. In the Western world this research has gone on for at least a couple thousand years. Within the last three or four hundred years a set of what are now called “Historic Temperaments” were established and used for compositions.

One of these tuning approaches, known as **Pythagorean Tuning**, is a historic temperament that favored pure fifths and octaves, with resulting very wide major thirds. A very popular later version is called **Meantone** and favored major thirds, major sixths, minor sixths, and minor thirds. Both of these historic temperaments, when used to tune a keyboard instrument, had restrictions on which musical keys could be played. Those musical key signatures that a particular tuning would support had different moods or types of musical expression associated with them. But play in the wrong musical key and you will get harsh unplayable chords from what are called “wolf intervals.”

Another set of historic temperaments is known as **Well Temperament**, which were also considered “circulating temperaments” since the multiple versions of Well Temperament could be used to play all the musical keys around the circle of fifths. Each version of Well Temperament had certain characteristics and are known by the names of the tuners who fostered them, such as Werckmeister, Kirnberger, Neidhardt, and Vallotti.

In the centuries when these historic temperaments were in use, before the adoption of the modern (Equal Temperament) tuning approach in 1917 and as shown for Figure 2 above, it was common for composers such as Beethoven, Liszt, Mozart, Chopin, and Schubert to choose a musical key signature to compose in, based on the mood or message intended for the musical composition.

### **Modern Piano Tuning and its Effect on Musical Expression**

In the early 1900s, the piano manufacturing industry began to gear up and produce pianos by the hundreds of thousands each year. An important part of the environment to support this activity was to have an appropriate, universal tuning temperament capable of supporting the playing of all different types of music compositions without the instrument needing to be tuned on a per-composition basis. In 1917 the use of “**Equal Temperament (ET)**” was finalized and adopted as an industry standard.

Equal Temperament has a very solid mathematical foundation, rather than the musical foundation of the historic temperaments that preceded it. Each note with ET is an exact mathematical multiplier (twelfth root of 2) times the preceding note or half-tone. The good news is that ET successfully supported the subsequent growth in piano sales. The bad news is that ET eliminated musical expression being connected to a key signature, with the lone exception of a major key differing from a minor key. Many musicians in the early 1900s were very upset with ET for reasons explained, but now over time most pianists, and most chamber music players who play in accompaniment with pianos, are used to the quality of Equal Temperament and do not expect anything different from a tuned piano.

### **A Few Cents**

For those who are mathematically inclined, “cents” is a logarithmic measure of frequency with 100 cents defined as the difference of a half-tone, or two adjacent notes on the piano. In an ET tuning, the Major Third is widened by 14 cents relative to a pure or just interval, which is quite noticeable when the interval is played. The Minor Third is narrowed by 16 cents, the Major Sixth is 16 cents wide, the fourth is 2 cents wide, and so on.

### **Expression Within Piano Playing**

A good student of the piano needs dedication and practice and the guidance of good teachers to achieve a level of achievement that matches their objectives. Much skill must be taught and learned, including a lot of hand technique such as dynamics and staccato and touch, and pedal and half-pedal control.

## **Hybrid Pianos – Enhanced Expression Plus More**

The hybrid piano adds another degree of knowledge to a pianist's performance dependencies, the requirement to choose the tuning of the instrument that is appropriate for the musical piece being played, as well as the appropriate key signature for which the temperament is targeted. As indicated earlier, the pianist will also select the model of piano to be simulated, as well as the acoustics for the room in which it is located. And there more options, such as wanting it to sound like a harpsichord or selecting the tactile characteristics, or feel, of the keys and pedals. Of course, the hybrid piano also has typical capabilities of the general digital piano family such as a MIDI interface, reverb adjustments, various inputs/outputs, recording, collaboration capabilities, additional functions in support of teaching, and more.

Prices for new hybrid pianos vary, with Yamaha and Kawai being among the leading producers. MSRP prices for uprights can start at over \$5,000 and for high-end grands can reach more than \$50,000. Setting the temperament and the musical key for a temperament is supported by a user interface and is explained in the manual for the instrument. Kawai calls the temperament-setting section of their user interface the "virtual technician." For both Yamaha and Kawai, as described in their user manuals, one first chooses the type of temperament, such as Pythagorean, Meantone, Werkmeister, and a couple others. Then one must select the key signature for the temperament in which you will be playing, what Yamaha calls the "base note" in their manual and Kawai calls the "temperament key."

## **Piano Sales**

One item of interest would be the numbers of hybrid pianos that are sold yearly since their inception in 2009. The closest available public numbers are for digital pianos, which incorporate a lot more sub-categories than just the hybrid piano. In 2021 there was a 24% yearly increase to a total of 234,000 digital pianos sold in the US, with a corresponding two-year increase of roughly 34%. Meanwhile acoustic piano unit sales have continued their yearly decline. The last two years show a net decline of approximately 5.9%, with 2021 US unit sales being 29,236 as compared to 228,000 in 1980.

## **Chamber Music**

There is much beautiful music written for violin, viola, and cello that is played in accompaniment with a piano. Descriptive material on the topic attributes successful performances being based on intonation, staging, matching of color and harmony of the piano, balance, rubato, technique, interpretation, and other challenges of chamber music including sensitive collaboration.

But the temperament that the piano is tuned in is usually taken as a given, Equal Temperament, and the string player is expected to adjust. The string player is expected to play in tune with the piano, the sign of a good string player. It is understood that such string instruments capable of making "micro-tunings" on the fly will do so during a performance. The hybrid piano

now, for the first time, treats the piano as a micro-tunable instrument as well. It is set at the start of a performance, or at the start of different movements, for the tuning that has the appropriate harmonic quality for the piece being played. The piano does the same micro-adjustment of temperament that a string player has previously been expected to do since equal temperament was chosen as the standard for tuning pianos.

The capability of expression in the playing of chamber music is the clear winner when a hybrid piano is in use and is tuned to the appropriate historic temperament.

### **Music Composition**

Up to this point we have mostly focused on music expression capabilities with a hybrid piano from the perspective of the piano player and the listener. The hybrid also has an effect on the composer. Composers must be able to “visualize” their music, that is, hear it in its full emotional presentation and, regardless of the instrument that is the target of the composition, a piano is often used in that visualization. Just as in playing, a hybrid piano with its ease of tuning to different versions of the hundreds of historic temperaments provides a vehicle for the composer to choose key signatures and choose the addition of emotions via temperament. This is capability that Liszt, Beethoven, and other classical composers routinely possessed, but that has been mostly absent from composers’ environments for the past 100 years.

### **A Final Note**

The use of expression based on tuning temperament in piano compositions that was very much present prior to 1917 has now returned to the piano environment over the past 10-plus years in the form of hybrid pianos. As the title indicates, “what goes around comes around.” As already noted, performers were very upset in the early 1900s and earlier as Equal Temperament was being established as the industry standard for the tuning of pianos, with the resulting modifications to many musical intervals and elimination of many tuning temperaments that had been in use. Now, more than 100 years later, the expression capabilities offered by the set of historic temperaments has returned to the keyboard environment, and are accessible in a manner that is more practical than was ever previously achievable. This is an interesting situation for the music-loving public and provides another example of the effect that computers can have on our daily lives! The hybrid piano builds upon all the musical features and capabilities of the acoustic piano while adding new functionality based on its embedded digital computer.

The acoustic piano will not disappear, with most musicians preferring the acoustic piano and there being performances where its presence is a given. I enjoy tuning and servicing acoustic pianos and have done so for a long time. But I hope that this article has introduced the additional musical capabilities that are now available with hybrid pianos.

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the Piano Technicians Guild in 1957.) Additional training in piano technology includes an apprenticeship under William Hupfer, chief tuner-technician of the Concert Department of Steinway & Sons, New York City, and an apprenticeship under Fred Hemry, a Registered Piano Technician in Bethesda, Maryland. The author is a member of Master Piano Technicians of America (MPT). Other higher education includes a master's degree in computer science and a Ph.D. in physics. The author may be reached at PotomacPiano@verizon.net, or through his website, <https://potomacpiano.com>.

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## **Additional Reading**

For those who are interested in follow-up on the topics presented, the following list might be of assistance.

1) Larry Fine is a well-known author on the purchasing of acoustic pianos. His latest addition on digital pianos can be found at: Alden Skinner and Larry Fine, "Hybrid Pianos", Piano Buyer -- Buying Guide, May 3, 2022, updated June 15, 2022.

<https://www.pianobuyer.com/post/hybrid-pianos>

2) A very good background on historic temperaments can be found at: Fred Sturm, "A Clear and Practical Introduction To Temperament History," Piano Technicians Journal, nine articles published May, 2010, through March 2011. See also:

[https://www.researchgate.net/publication/329591485\\_A\\_Clear\\_and\\_Practical\\_Introduction\\_to\\_Temperament\\_History](https://www.researchgate.net/publication/329591485_A_Clear_and_Practical_Introduction_to_Temperament_History)

3) One of several books available on the subject of Equal Temperament versus historic temperaments is: Ross W. Duffin, *How Equal Temperament Ruined Harmony* (New York: W. W. Norton & Co, 2007), Chapter 2.

4) I suggest that the interested reader listen to the audio difference in musical pieces played in both Equal Temperament and historic temperaments: Radford Piano Services, Carl Radford, "Videos – Classical vs Modern Tunings," May 9, 2014, <https://www.radfordpiano.com/soundboard/videos-classical-vs-modern> and his YouTube video: <https://www.youtube.com/watch?v=4csEYkJKRk>. See also: Carl Radford, "Historic Temperaments: A New Trend In Piano Tunings," The Newsletter of the North Shore Chapter of the Piano Technicians Guild, December, 1991, issue,

<https://www.radfordpiano.com/soundboard/historical-temperaments>.

5) Philadelphia Piano Institute, "Hybrid Pianos: Your Complete 2022 Guide," accessed August 22, 2022, <https://philadelphiapianoinstitute.com/hybrid-pianos>.

6) Scott Cole, "Hybrid Pianos: A Primer For The Technician," Piano Technicians Journal Volume 64 Number 8 (August 2021), pp 10-13