CLIMATE CONTROL AND STABILIZING PITCH
BY LOU TASCIOTTI

**Lou Tasciotti is Technical Editor for The Piano Quarterly,
Piano Technician at The Crane School of Music, Potsdam College of the State University of New York, and a Registered Craftsman in the Piano Technician's Guild.**

A piano tuning, taken as a noun, is an intangible, subjective and often too temporal state of being. All things being equal, it is the temporal aspect of a tuning that is often used to praise or condemn the quality of a piano technician's work. And understandably so what good is the best tuning if it doesn't last? There are however, two factors to consider here that will determine the longevity of a piano tuning. The first, obviously, is the skill of the technician. The second, is the environment that the piano resides in.

How does one differentiate between these two factors to find out why a piano tuning may be short-lived? A simple test will give you the answer. Immediately after the piano technician has left, sit down and quietly listen to the tuning, especially the purity of the unisons. This is the time to judge the accuracy of the tuning as well as to get familiar with it. Assuming that you are satisfied with the way the tuning sounds, proceed to play the piano very vigorously. After giving the piano a good workout for about half an hour, listen to the tuning again. If the tuning survived, then it was a good one. From this point on the tuner has no control over what happens. Whether or not the tuning sounds good the next day, the next week or three months later, is up to you. Providing the right environment for your piano is what will now determine the longevity of the tuning.

The right environment for a piano is one that is stable in temperature, and even more important, in humidity. A stable environment will not only extend the life of a tuning, but will also extend the life of the piano and reduce future maintenance costs.

The first step in providing a stable environment for your piano is to select the right location. Placing your piano next to a radiator, heating vent or wood stove results in a most damaging environment.

Keeping your piano at least five feet away from any heat source is a safe rule of thumb, and be sure that no hot air vents are blowing in its direction. Drafty doors and windows should also be avoided, and even keeping your piano away from air return vents in-forced air heating systems is a good idea. Direct sunlight will also have a very deleterious effect on your piano. In old houses with little or no insulation, you should also avoid placing your piano against an outside wall. Following these fundamental guidelines will keep you from making any serious mistakes when providing for your piano, but this is just the beginning.

Pianos are wooden instruments and wood is extremely sensitive to humidity changes: it shrinks when the air is dry and expands when the air is humid. Changes in atmospheric humidity are the real culprits for putting a well-tuned piano out of tune.

One of the most humidity-sensitive parts of a piano is its soundboard. Piano soundboards are truly remarkable in their construction. Only 3/8 of an inch thick at its center, a soundboard can be upwards of six plus feet long by four plus feet wide. Furthermore, a soundboard is curved. Supported on its underside (in a grand) by a series of one inch wide ribs, this thin sheet of soft wood is strong enough to withstand several hundred pounds of string pressure pushing down on it.

Like all stringed instruments, the soundboard of a piano is straddled by a bridge. The strings pass over the bridge which transmits vibration to the soundboard. An increase in humidity causes the piano's soundboard to expand. Since the sound board is curved (upward in a grand), it rises up, pushing the bridge and the strings up as well. This increases the tension on the strings and causes their pitches to go sharp. Likewise, a decrease in humidity will shrink the soundboard and the pitches will go flat.

Whether a piano has been played or not, a large change in humidity will have a drastic effect on the tuning. Some of the concert grand's that I care for receive up to twelve hours of use each day including perhaps four recitals on any given day. During periods of relatively constant humidity I have seen these heavily played instruments remain almost in perfect tune over the course of several weeks, requiring merely touching up an occasional slightly stray unison in that time. However, during periods of unstable humidity I have had to completely retune these same instruments almost daily. Obviously, controlling humidity is the key to having a good tuning remain stable.

There is a relationship between humidity and temperature. Warm air is able to hold more moisture than cold air. At any given temperature there is a maximum amount of moisture that the air can hold. This maximum amount is referred to as 100% relative humidity. If you heat the air without adding any additional moisture, you will lower the percentage of the relative humidity because the warmed air can hold more moisture. This is what happens when you heat the air in your home. The relative humidity goes down as the temperature goes up.

Porous objects such as your piano contain moisture. Their moisture content will seek to reach an equilibrium with the air. As the relative humidity of the air goes down, the air will act like a sponge-and draw moisture out of any porous object. Conversely, when the relative humidity goes up, porous objects will draw moisture from the air. To keep your piano from experiencing radical changes in humidity, it is necessary to add moisture to cold air as you heat it and remove moisture from warm air that has too much moisture in it.

What is the ideal relative humidity for a piano? The ideal humidity is far less important than the consistency of the humidity level. Although 30 to 10% relative humidity is a considerably dry environment, a piano that has been acclimated to this environment and kept between 30 to 40% will remain quite stable. Whereas, although 45 % relative humidity is

considered fairly optimal, a piano in an environment that fluctuates from 35 to 55% is going to require a lot more tuning as well as other maintenance.

Avoid extremes. A relative humidity of 30% or less is an invitation to trouble. In this dry environment you run the risk of having wood parts of the piano crack and glue joints fail. At 60% relative humidity or higher, piano strings and tuning pins may start to rust.

I suggest you buy yourself a hygrometer to measure the relative humidity and keep it close to the piano. Hygrometers, usually coupled with thermometers, are fairly inexpensive - ranging from the $6.00 hardware store variety to the $30.00 decorative style found in home furnishing stores. For the sake of accuracy, make sure that you keep it away from heating vents, drafts, direct sunlight, and outside walls.

There are essentially three ways to control the humidity changes that your piano may experience. If you have a forced air system, you can have a humidifier built directly into your central heating/air conditioning system. Otherwise, use a portable humidifier in the dry season and a portable dehumidifier and/or air conditioner in the humid seasons. A third approach is to have a miniature climate-control system installed by a piano technician directly onto your piano.

It would be ideal to stabilize the total environment that the piano is in, but this isn't always practical or economical. In areas with extremely cold winters, unless you have a very tight house with excellent thermally insulated windows, trying to keep the humidity level up can be a bit of a problem. The extra moisture will condense when it comes in contact with cold surfaces like non-thermal windows or un-insulated walls. This type of condensation will cause wood surfaces to rot. Portable humidifiers are also rather annoying to use. They must be refilled. With water very often, cleaned occasionally, and can be rather noisy. The new breeds of ultrasonic humidifiers are almost silent, but need to be refilled more often and don't have the same output as the older floor model type. Another problem with

portable humidifies is that if you go away on vacation they may not get filled and thus the room will get quite dry.

A climate control system installed directly onto your piano can be very effective. This type of system consists of a low-wattage heating element (dehumidifier) and a water reservoir with an evaporator (humidifier) that mounts on the underside of a grand piano or inside the bottom of an upright. The system is controlled by a humidistat that turns on the humidifier or dehumidifier as needed. There's even an indicator light to tell you when to refill the reservoir, which is usually never more than once a week. The one drawback of this type of system is that it is localized and its beneficial effects don't extend equally to the entire piano. While I recommend these systems as being economical, effective, and maintenance-free, I suggest that they are supplemented with a room humidifier in extremely dry environments.

Aside from changes in humidity, there are other reasons why a well-tuned piano in good condition can go out of tune. When a string breaks and is replaced, the new string will go out of tune within a matter of hours. New strings will stretch for weeks or even months. New pianos or newly restrung pianos require far more tuning in their first year than they will later on. But one of the most common causes for a well tuned piano to be unstable, assuming that both the tuner and the piano are good, is that the pitch has not been stabilized.

Stabilizing the piano's pitch means not making any radical changes in the overall pitch of the instrument. Many European orchestras tune to A-442 or higher, as opposed to U.S. standard pitch A-440. Pulling a piano up to a higher pitch is going to leave the tuning unstable. This kind of major change in the pitch of a piano demands that the piano be tuned more than once to stabilize the pitch.

As solid as pianos may appear, they are in many ways quite flexible. Not only do they expand and contract with changes in humidity, but they also react to changes in tension. The string tension in a piano is enormous, with

a combined tension of upwards of 35,000 pounds. This tension translates into roughly 1,000 pounds of pressure bearing down on a typical soundboard and its bridges. Any change in string tension is multiplied by the approximately' 240 strings. As strong as the soundboard has to be, it must also be flexible so that it can vibrate freely. Therefore, even a relatively small change in string tension is going to have an effect on the soundboard.

Since the pitch of the piano must be kept relatively constant, any substantial changes will cause the soundboard and bridges to begin flexing. Pulling up the pitch in one octave will cause a previously tuned octave to drop in pitch, and vice versa. Even if a technician goes over the tuning several times, the piano will continue to be unstable for days afterwards.

The only way to achieve timing stability when you have to substantially change pitch is through a series of tunings. The number of tunings needed for the piano to stabilize depends on how much the pitch has to be altered. The first and second tunings in a major pitch changing process do not really resemble tunings. After the radical pitch change a piano may not necessarily sound any better because it is still out of tune, but at least the overall pitch of the instrument is in the right ball park. Technicians usually refer to these preliminary tunings by other names, such as pitch raising, pitch lowering, or shop tunings.
How far out of tune does a piano have to be to require more than one tuning? It is generally accepted that a pitch change of eight cents or more will exhibit noticeable instability. For those readers not familiar with the term cents, one hundred cents equal one chromatic half step. So, from the point of tuning stability, if a piano's pitch is off by a quarter tone (50 cents), that is considered extreme.

To give the reader an idea of how far out of tune pianos can get from one season to the next, let me provide the following example. I set a piano aside to remain un-tuned and un played for a period of one year. The pitch of one note (A = 440 Hz) was measured each day, along with the relative humidity of the room containing the piano. The relative humidity

recorded was typical of the extreme range that we find in New England. That is, some relatively humid springs and summers and very dry winters. The indoor .relative humidity recorded in the room where the piano was located varied from 65% in July to 19% in February. During that time, the maximum pitch change was 29 cents.

If we divide this pitch change, 29 cents, by the maximum amount of change allowable for a stable tuning, 8 cents, as mentioned above, we find that this piano would have had to be tuned at least three times between July and February. Add these two tunings to the other three and we find that this piano needed to be tuned five times, if we want each tuning to be stable. That is a lot of tuning.

This kind of pitch instability is an unnecessary problem. Using an effective form of climate control can reduce the seasonal pitch changes of the piano to a negligible amount. Your tunings will last a long time, and when you finally do need the instrument attended to, it will be a bit of a luxury instead of a desperately urgent situation.