HUMIDITY AND TEMPERATURE

In order to care for your piano properly, one of the main measures to consider is climate control. Pianos are mostly made of timber and can be significantly affected by changes in the relative humidity (RH) in the air. Consequences vary from tuning instability in the short term to regulation issues and reduced piano longevity in the long run.

So important is the need to control the environment around the piano that some manufacturers will not honour their warranty if the piano has been exposed to RH levels outside 40%-60%. With high humidity, swelling forms compression ridges on the soundboard, strings rust, verdigris jams centre pins. Low RH can cause cracks as the timber dries and shrinks. Some of this damage can require very expensive repair.

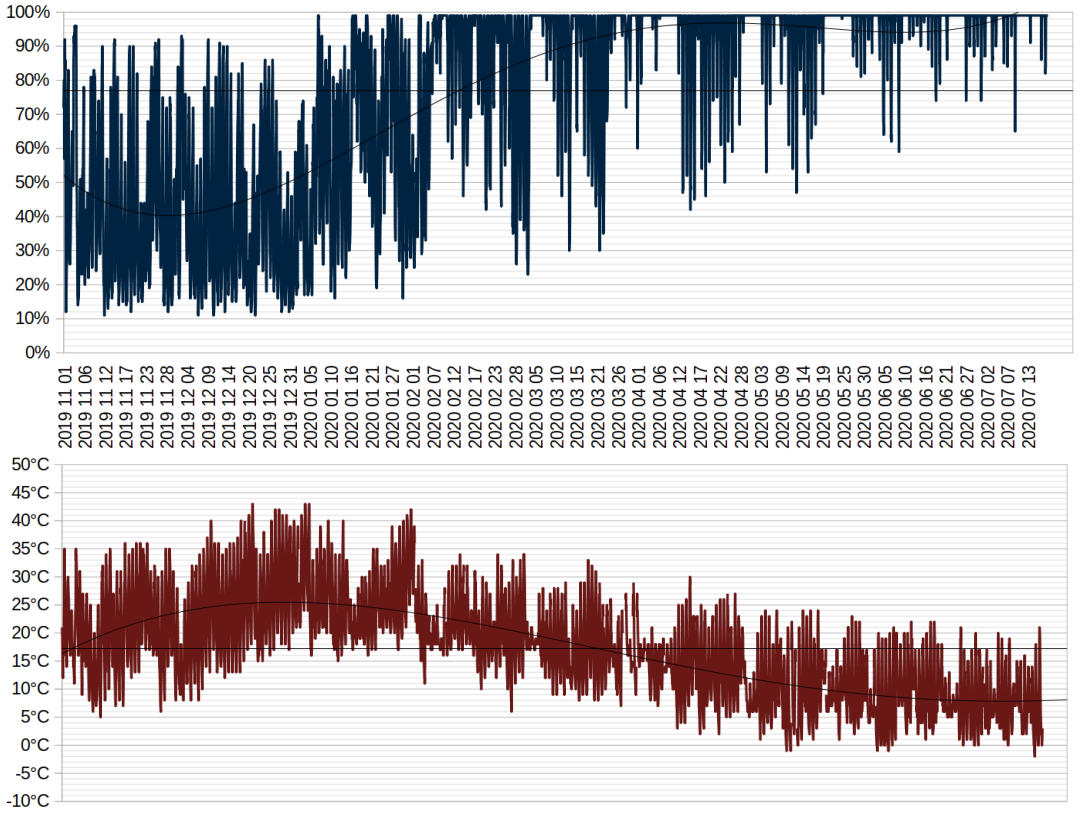
What is RH

Relative humidity is the percentage of water vapour that is present in the air, in relation to the total that the air can hold when condensation starts (100% RH). RH can vary with changes in temperature and pressure. Changes in temperature, unless drastic, are not a major concern for pianos, it is their effect on RH that can cause trouble, as RH increases when temperature drops and decreases when temperature rises.

In Bathurst, summers are generally warm and dry, winters cool and wet. During the day, temperature and humidity move in opposite directions, as you would expect. When the air cools down, the movement of air and water molecules is slower, so more molecules can fill up the space, resulting in a higher RH reading. As the air warms up, molecules get more agitated and need more space, so less of them will be counted in the room, hence a lower RH reading.

Seasonal changes push the ranges further up or down, but the pattern tends to remain the same. As a consequence, it is fairly easy to adjust the RH inside our workshop to a reasonable degree of satisfaction, by having good building insulation and controlling the temperature with a small heater or cooler. Other places are different - in Sydney, the sea proximity keeps humidity levels fairly stable, and pianos do not tend to behave as wildly.

Humidity (top) and temperature (bottom) in Bathurst, Nov 2019 to Jul 2020



In Darwin, on the other hand, the dry season is cool and the wet season warm (never mind the build-up!), so some form of control is usually necessary. Conveniently, most air-con systems dry up the air while cooling it down, so this could work well in warm and wet months, unless they are switched on and off frequently, which is often the case. It is also common for institutions to turn the system off at night and on weekends, accentuating the fluctuation. In the opposite season, with cool and dry days, only a dedicated humidifier can help.

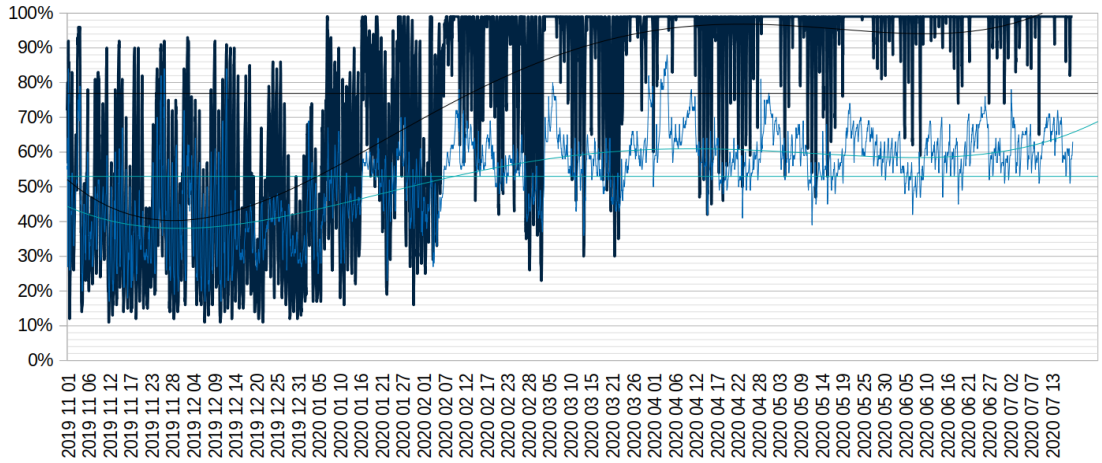
What can be done

The ideal solution for climate control anywhere is a system that keeps both temperature and humidity constant for the whole room at all times, but we normally find those in major venues only. Some places have a controlled small storage room for their finest pianos, which are only rolled out on stage just before performances. This works well as long as the piano is not left out for a week in an environment that is completely different to its storage room, otherwise again the fluctuation is exacerbated.

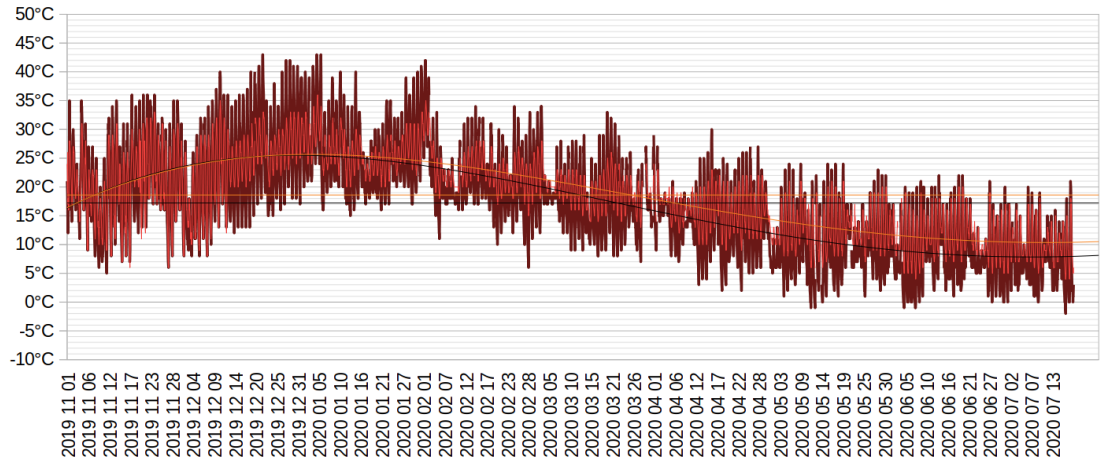
We built our new workshop in 2019 using insulated blocks, double-glazed windows and doors, and an air-cell lined roof. We installed sensors inside and outside in November to monitor the humidity and temperature variation, and despite the quality of materials used, the fluctuation was still rather high. Further investigation revealed that the roof was leaking much more heat than the rest of the building. Once we added an extra layer of heavy-duty roof insulation in mid-December, the change was noticeable.

Considering that the level of insulation we have in our workshop is above what we find in the average home, and that the benefit we get is just enough to maintain humidity and temperature within reasonable levels, it is easy to see the potential risk for pianos in rooms with no insulation at all.

Humidity outside (dark blue) and inside the workshop (light blue), Nov 2019 to Jul 2020



Temperature outside (dark red) and inside the workshop (light red), Nov 2019 to Jul 2020



Portable devices

As an extra layer of protection, there are dedicated humidifier/dehumidifier systems that can be installed inside upright pianos and underneath grands. Such systems can mitigate the RH fluctuation to some extent. They work by having a humidistat monitoring the RH level and adjusting it by either turning on a heating rod to dry up the air when RH is too high, or evaporating liquid from a container when it is too low.

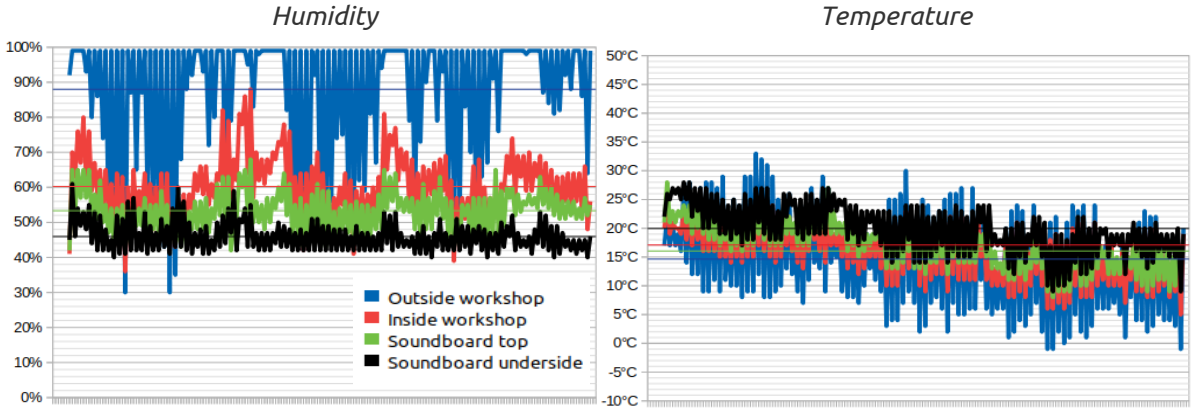
As a safeguard measure, we normally have one of those installed on pianos while they are in our workshop. The instruments remain very stable, but we note again that conditions inside are already within an acceptable range to start with. Expectations should be realistic, as in a tropical home with louvres open 24/7, the piano is practically outdoors and results can vary.

These systems have their inconveniences, some models can cost in excess of $1,000 and they also need regular monitoring, requiring a manual refill every week or three. Missing the blinking light may result in an empty tank that can cause the humidity to drop even more sharply than if the device had not been there at all.

As an example of their potential efficiency, below are the average RH readings for a recent grand rebuild project that lasted three months:

Sensor Location	**Avg. RH**
Outside Workshop	89%
Inside Workshop	60%
Soundboard top	53%
Soundboard underside	46%

The fluctuation during daytime was occasionally fairly wide, even though RH peaked at 100% every single morning.



The difference between the top and bottom of the piano (7% RH) caught our attention, and may or may not be reason for concern in the long run, we do not have enough data for conclusions. As most manufacturers allow the device to be installed without affecting warranty terms, it should be safe to assume that it is not an issue.

Refills lasted between 16 and 30 days. Daily checks were required, given the uncertain duration of a refill, and away trips needed a regular visitor to feed the pet if necessary.

Humidity and Tuning

The effects of humidity swings can show up in the tuning in a matter of days. Piano soundboards are slightly crowned, sitting higher in the centre than around the edges. When humidity drops, the wood shrinks and the crown flattens. This downward movement releases some of the string tension, causing the pitch to drop. Conversely, when humidity rises the opposite happens, except that the upward pressure on the strings is not usually quite enough to reverse the slack created with the drop. So when the next cycle starts, the piano is already at a slightly lower pitch.

In many places, the scenario above happens every year with the change of seasons, and this is one of the reasons why a piano should be tuned at least once a year, even if it does not get played much or does not sound too bad. In certain places where summers are relatively dry, a rainy spell of several days can have a similar effect, resulting in a pitch change that would normally take a year to occur.

In addition, individual notes can have up to 3 strings of same speaking length (the vibrating section) but different overall lengths, so the rise and fall of the soundboard can affect them differently, causing unisons to shift out of tune.

Extreme weather events can have drastic effect on tunings as well. The humidity in Bathurst dropped to 11%h during the 2019-2020 bushfires in the Blue Mountains. Many pianos in the area had strings slipping over a semitone flat, as the shrinkage was so severe that the pin block could not provide enough friction to hold the tuning pins in place. Once RH levels were restored, tuning held up normally again.

Pitch-Floating

For instruments that are exposed to wide swings of humidity levels, a floating pitch may be adopted, particularly if they are tuned several times a year. Maintaining the pitch at A440Hz requires it to be raised during dry periods and lowered during wetter spells. This, naturally, creates tuning instability. Considering that the pitch swing is seasonal and will gravitate around the average, it is often preferable to work within a window, say, between 439Hz and 441Hz. This will minimise both the need for adjustments and their magnitude. This is common practice in schools and other music institutions.

The ability to play with other instruments is affected less than one might expect, because octaves on a piano are stretched. When A4 is tuned to 440Hz, A3 is flatter than 220Hz and A5 sharper than 880Hz. By floating A4 up, A3 will be closer to 220Hz, and when floating A4 down, A5 will lean towards 880Hz, so the standard pitch benchmark is merely shifted up or down the octaves.

In general, we find that the benefits of pitch-floating for stability are far more significant than the inconvenience caused by the pitch variation.