

# **Repair and tuning of bamboo instruments**

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## **Introduction**

The techniques described in this report are adapted by Samuel Wantman from those of Pak Made Terip, a master maker of bamboo. Marc Paelinck has made some additions after his own experience with repairing and tuning four instruments.

# Repair

## ***Material***

- epoxy resin or polyester resin
- strips or splints of wood or of bamboo to fill larger gaps

Use epoxy resin for small cracks and to install the splints. If you heat up the epoxy with a hot air gun, it will flow into the cracks. Sometimes it takes a few applications to fill them. One drawback of epoxy is that it does not adhere well to bamboo.

An alternative is to use polyester resin. The resin is sometimes sold with glass fibres mixed into it. At this moment, it is not yet known how this material stands up to abuse and seasonal weather changes. It's a two-component material that is used to repair the body work of boats and cars. Once the components are mixed together, you only have 5 to 10 minutes before the paste becomes too hard to handle. Always mix just enough of the components for the amount of work you can do in that short span of time. The paste adheres fairly well to wood and excesses can be cut away while the material is still soft.

## ***Tools***

- sharp knife or Stanley knife
- wooden spatulas
- (optionally) a workbench and an electric jig saw
- duct tape

## ***Narrow cracks***

**Using polyester resin** - Cracks up to three quarters of a centimetre (about a third of an inch) can be filled completely with resin. Smear the paste on the crack and press it into the crack with a pointed object, for instance a piece of wood which you have sharpened into a wedge with a sharp knife. Continue this process until you are certain that the cracks are filled completely. Cut the excess away with a sharp knife after the resin has hardened enough to resist pressure but before it has hardened completely (usually somewhere between 5 and 20 minutes after you mixed the components).

Don't worry about the extra resin that sticks out on the inside of the tube. There are often irregularities inside the tubes (like when a node is removed) and these do not affect the sound. In very rare cases, the material that sticks out can cause an undesirable noise when you hit the tube. If this is the case, you will need to remove that material. One way to do this is to use a Dremel tool (see the list of tuning tools below).

## ***Wide cracks***

Cut a strip of wood or bamboo roughly to the size of the crack. To draw the contours of the crack on the strip, insert the strip inside the tube and press it against the crack from the inside. Use a pen or a pencil to draw the contours of the crack. With thicker material, you can use an electric saw for the rough shaping, then use a knife for the fine work.

**Using polyester resin** - Apply some resin on the edges of the crack and press the bamboo strip into the crack. Hold it in place while applying more resin on the remaining openings. Use a wooden wedge to press the resin firmly into the cracks. Cut away the excess of resin before it has hardened completely

### ***Long wide cracks***

**Using polyester resin** - For long, wide cracks, insert the wooden or bamboo strip into the crack and start working with the resin on one end of the bamboo strip. Then wind some duct tape around the tube at the place where you finished working on. This way, the bamboo strip will remain in place at one end as you proceed to fill the gaps with resin along the rest of the strip. Sometimes it will be necessary to use duct tape in more than one place. The duct tape can be removed after several minutes: the resin will already have hardened enough to keep the strip in its place. The tape will not stick to the resin, even if the resin is still soft. This method can also be useful if you need to bend the bamboo strip to follow the contours of the crack.

## **Tuning**

There are two components to a tube: the half round part and the closed resonator. Both have to be the same pitch. It is actually easier to lower the pitch of a key than to raise it. Almost any tuning problem can be fixed, with one limitation. If the pitch of a key has to be raised too much, it might become too short for the stands. So that is the most critical constraint. Even in that case, it is possible to adjust the stand to support a shortened key.

## **Tools**

- A very sharp mat-knife or box cutter. The Balinese make a wonderful knife for carving bamboo, but they are nearly impossible to find outside of Bali.
- A Dremel tool (as an addition or alternative to a knife) with a coarse grinding cylinder.
- Masking tape
- A chop-saw or handsaw for cutting bamboo
- An electronic tuner that shows pitch and cents
- A drill
- A rubber mallet

A Dremel tool is an electric device that can be used to drill, grind and polish small surfaces. If possible, use an extension which is connected to the tool through a flexible transmission. The extension is smaller than the Dremel tool itself and is easier to handle. In most cases, it will also fit into a tube enabling to remove excess material from the inside. You can use the tool as an alternative to a knife to remove material around the opening of the bamboo. A disadvantage of the tool is that the friction of the grinding will raise the temperature of the tube. This will influence the tuning. You will need to let the tube cool down after each grinding pass in order to measure the new pitch accurately.

## **Terminology**

*Daun* - The part of the key that is half round that is like a key.

*Bung* - The part of the key that is not carved that is like a resonator.

## **Method**

### **Determining the right pitch**

First consideration is to determine what the pitch of the key should be. This is sometimes more difficult than it seems. If you have more than one instrument, we suggest measuring the frequency of all the keys of all the instruments using a tuner and making a chart or spreadsheet.

For the keys that are out of tune, measure the pitch of the *daun* and the *bung*. Sometimes this is easy and sometimes it is difficult. Blowing across the opening to the *bung* does not give you a very accurate reading. Try singing the note into the opening (without getting your mouth too close) and listening for the strongest resonance.

Another way to measure the *bung* is to stand the bamboo tube on the tip of the *daun* on a soft surface (a rug or your leg). Place the microphone of the tuning device near the opening of the *bung* –not too close so as not to influence the pitch– and hit the bottom of the tube several times with a rubber mallet. This will not work with every tube. The rate of success will depend on the quality of the tone and the accuracy of your tuning device. If you hear a tone but the tuning device can not measure it, try singing it. You will need a good ear and a steady voice for this.

Measuring the *daun* is easier. You can hold the meter at the tip of the key while you hit it with the mallet.

Decide which keys need to be tuned and which do not. If there are multiple instruments and many out of tune keys this can be pretty complicated. Figure out which part of the out of tune keys need to be adjusted. For example, the *bung* might have to be raised so many cents and the *daun* might need to be lowered. If you can, adjust the tuning so that a minimal number of keys need their *daun* raised. The easiest thing to do is to lower the pitch of the *daun*.

### **Tuning**

Once you know where you are going, tune the keys in a controlled climate. Don't tune the instruments on the hottest and driest day of the year, or the most humid, or the coldest. The instruments will sound the best when the weather matches the conditions when they were tuned.

Tune the instruments by raising or lowering the *daun*, and raising or lowering the *bung* until they match. First tune the *bung*, and then tune the *daun*. Work slowly and measure the pitches with the meter frequently.

### **How to tune the bung**

To raise the pitch of the *bung*, carve away a bit of the bamboo from the opening. Try to keep the shape of the opening the same. It is very important that you do not carve anything from the area where the *daun* meets the *bung*. If the angle of the opening changes a little, that is not a problem.

To lower the pitch of the *bung*, cover part of the opening with masking tape. This can be a single strip of tape across the bottom edge of the opening. The opening will not stay round, but that is not a problem. Once you have the opening at the correct pitch, put a few more layers of tape on it to stiffen it. After you are done tuning, you can replace the tape with a thin sheet of wood and

glue it to the opening for a more permanent fix. If you do this, make the wood a little bigger than it needs to be and carve it so that it is the correct pitch. You can carve the wood to make a rounded opening, but this is not critical.

### ***How to tune the daun***

To lower the pitch of the *daun*, carve a little bit of bamboo from the edges of the *daun* near the opening of the *bung*. A tiny sliver will noticeably lower the pitch, so check your progress with the tuning meter frequently. Take an equal amount from both sides. Keep the edges even and smooth as you carve.

To raise the pitch of the *daun*, shorten it by sawing the end. You can approximate how much you need to remove mathematically: a six percent change in length is roughly a semitone. If you cut too much and the pitch is too high, you can easily lower it. Make the cut parallel to the original cut. When you are all finished, paint the end of the key. Painting the ends of the keys helps keep them stable.

It is also possible to raise the pitch of the *daun* by cutting the other end of the key. This is only possible if the original key had extra bamboo at that end. Often the keys are made so that there is no extra bamboo past the node. The node is the part of the bamboo that seals the opening the tube. You do not want to cut off the node, doing so will destroy the key. But, if there is extra bamboo to cut, it is better to cut from the *bung* end than the *daun* end because you might not have to redrill the hanging hole.

### ***Matching the pitches***

The most difficult part of the process is matching the pitches of the *bung* and the *daun*. As the pitches get close to each other it is hard to hear which is off. A couple of pointers:

- If the key sounds good leave it alone.
- Hit the key and then hit the key again holding the *daun* firmly just above where it meets the *bung*. You should hear the same pitch. If they are different you need to keep tuning. The open pitch is the pitch of the *daun*, and the closed pitch (when you are holding the *daun* firmly) is the pitch of the *bung*. You have to listen pretty closely to hear the difference. Try it on some out of tune keys to learn what to listen for.
- Use masking tape to experiment with the pitch of the *bung* to get a good sound. It is easy to redo the masking tape and hard to redo everything else.
- Be very careful tuning the highest notes. It is very hard to hear the pitch of the *bung*. Try to avoid tuning the *bung* of high notes.

### ***Double check***

Check the tuning a few days after you tune them the first time. They will likely need some adjustment.

### ***Hanging the tubes***

Rehang the bamboo after the second tuning. It might be necessary to move the hanging holes. Hold the key between two fingers at the hole and hit the key. If you feel the vibration with your fingers, move them to a different spot so that you find the node (the spot where it does not

vibrate). Often it will seem that there is a range of a few centimetres that you do not feel any vibration. Move a few centimetres in either direction from the spot you think is the node and feel the vibration. Both spots should feel the same. If one is stronger than the other, adjust the placement of the node towards the weaker spot. If the node is very close to the old hole, don't bother to drill a new one. You don't need to fill or patch the old hole.

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