Question to top luthiers: “What percentage of damage to instruments is caused by humidity?”

Answer: “All of it, except for domestic violence”

There is nothing more important to the care of a fine wooden instrument than maintaining a constant 45-50% relative humidity at room temperature. Depending on the instrument builder, you will find all of them recommend a humidity level in that range, but going below 40% or above 60% at typical room temperatures will start to cause damage. Most manufacturers do not cover damage caused by humidity in their warranties.

While too much humidity can cause damage, most damage occurs by the instruments drying out during winter months with very low relative humidity levels. Cold air holds much less moisture than warm air, so even if the weather man tells you that it’s 100% humidity when it’s 15 degrees outside, that’s about the same amount of humidity suspended in the air as 5% relative humidity at 70 degrees.

**How does the low humidity impact instruments?** Wood shrinks much more across the grain of the wood than along the length of the grain. As the humidity levels drop, the top of the instrument will shrink, and will start to slightly sink into the body. This will cause bracing in the instrument to come loose, and often causes a split in the seam in the center of the top as shown below:

![Image of split in instrument top]

Cracks may also occur on the back or sides of the instrument. The very best instruments are lightly built to improve sound, so if your instrument is particularly well made, it is more likely to sustain humidity damage than the more common factory-made instruments.
**Why does an instrument need humidity?** Fresh cut wood is full of water. About 72% of the moisture content of fresh cut wood is sap, and the remaining 28% is saturated in the fibers of the tree. Before building with wood, it's air dried for at least a year, and usually dried in a kiln as well. Moisture content of this dried wood is between four and eleven percent. Wood is never completely “dried out” it retains moisture content of 4-11% depending on the ambient humidity. Wood will typically gain or lose 1% for every 5% change in relative humidity in the ambient air.

Wood expands and contracts as the moisture content changes. What makes this a particular problem in a wooden musical instrument is that the wood doesn’t expand and contract evenly. Wood expands and contracts across the grain at 4-8% depending on the angle that the wood was sawn, and the wood species. It expands and contracts along the length of the grain about .01% (almost no expansion or contraction at all).

![Diagram of guitar with dimensions indicating expansion and contraction](image)

In addition to loose braces and cracks, you may notice that fret wires will protrude past the neck in winter because the neck wood will shrink. You’ll feel the sharp edges of the frets when you run your hand down the neck. Do not make the mistake of filing down the fret wire, as they’ll be too short when the neck re-hydrates.

**How do I measure my humidity?** You’ll want to know what the humidity is in your home. There are a lot of small inexpensive humidistats on the market that range from $3-$25. They are frequently inaccurate, but they’ll at least get you in the ballpark. You may want to buy several different brands and take an average of the readings. Calibrated humidistats are available and are more accurate, but are quite a bit more expensive. Being off by a few percent when humidifying an instrument is not a problem. If you’re in the 45-50% range, you’ll be fine.
What are my options for humidifying my instruments? There are a number of options and a wide range of price points for humidifying your instruments. The main variables are the cost of the humidification equipment and how frequently you’ll need to take action to keep it stable at the desired 45-50% relative humidity. Factors to consider are:

- **Where do you live?** If you’re in a location that rarely gets very hot or cold you may not need to do much. You can find some humidity history for your location at [http://www.shorstmeyer.com/wxfaq/humidity/rh.html](http://www.shorstmeyer.com/wxfaq/humidity/rh.html)
- **How many instruments do you have?** If you only have a few, and don’t do a lot of traveling, you may be fine with an inexpensive sound hole type humidifier.
- **Do you want to combine display or easy instrument access as part of your humidification solution?** There are several manufacturers that build humidified display cabinets that combine humidity management with display, easy access to instruments and security measures.

**Sound-hole humidification** is the least expensive and most common way of humidifying an instrument. A small sponge is enclosed in a plastic container that fits in the sound hole of the instrument. The instrument then is stored in its case. A concern is that the sponge may dry out very quickly, and you may end up with no humidity in the case. Monitoring the humidity level is critical. You must also be very careful not to drip water inside the instrument. It is an easy solution for a small number of instruments, but you need to check each case every few days. It’s also a good idea to put a small inexpensive humidistat in each case to see what the humidity level is.

**Chemical humidification** is a common upgrade from water based sound hole humidification. It replaces the sponge with a chemical pack that maintains a predetermined humidity level. You need to store the instrument with the chemical pack in the instrument case, or you may opt for a single instrument display case combined with a chemical pack. The packs last much longer than a sponge, but do need to be replaced every one to three months depending on your ambient humidity and how much humidity leaks out of the enclosure you are keeping the instrument in. The chemical packs are fairly cost effective for one or two instruments, but if you’re trying to humidify more instruments, dozens of humidity packs every month or two starts to add up to a lot of money.

**Room humidifiers** are a popular solution for anyone with a large number of instruments. For approximately $100 you can get an evaporative humidifier that will keep a room at 45% relative humidity. The best ones are controlled by a digital humidistat that turns them on as needed to maintain a desired humidity level. Unfortunately dry wall used in most homes does not hold moisture in. A typical room will require two to four gallons of water a day. The moisture may become trapped in wall insulation and cause mold. If you’re using a room humidifier, you may want to look at your moisture barrier for the room, and line the room with cedar.
**Whole house humidifiers** are available, but generally are not designed to maintain humidity of 45% or more in cold climates. They’re intended to make humans comfortable at about 30% RH. Systems are available that will maintain 45% relative humidity, but are generally designed for commercial applications and are much more expensive.

**Humidified display cabinets** are available to hold single or multiple guitars with built-in evaporative humidifiers. Some are also available with dehumidifiers. They’re designed to keep your instruments at 45% relative humidity, and in easy reach to take out and play. They offer excellent utility, but are expensive.

Here’s a summary of the options, with pros and cons:

<table>
<thead>
<tr>
<th>Humidification type</th>
<th>Approximate Cost</th>
<th>Pros</th>
<th>Cons</th>
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<tbody>
<tr>
<td>Storing in a case with no humidification</td>
<td>$0</td>
<td>None</td>
<td>Storing in a case without a humidity device of some kind provides no benefit and will not protect your instrument.</td>
</tr>
<tr>
<td>Storing in a case with Dampit™ or sound hole humidifier</td>
<td>$2-15</td>
<td>Inexpensive. These are good for travel, or if you have a small number of instruments that you check regularly.</td>
<td>Easy to forget to check if the humidity device has dried out. Generally they need to be rehumidified every few days. May cause damage from water dripping in your instrument.</td>
</tr>
<tr>
<td>Humidipack™ and similar chemical humidity management packs</td>
<td>$10 per month</td>
<td>Moderate cost for a small number of instruments (about $40/year per instrument). Better than water based sound hole humidification systems.</td>
<td>Can only be used in instrument cases, and becomes expensive when you have more than a few instruments.</td>
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<tr>
<td>Room humidifiers</td>
<td>$100</td>
<td>Evaporative room humidifiers generally run about $100 and work well for humidifying a reasonable size room. It’s important to get one that allows you to set a desired humidity level.</td>
<td>A room humidifier requires a lot of water. Generally two to four gallons a day for most rooms. Moisture going through sheet rock walls may cause mold in insulation.</td>
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<tr>
<td>Whole house humidifiers</td>
<td>$350 and up</td>
<td>Adds humidity to your home in the winter, and makes for a more comfortable living space.</td>
<td>Generally whole house humidifiers won’t maintain the 45-50% humidity recommended by instrument builders</td>
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<tr>
<td>Humidified display cabinets</td>
<td>$800 and up</td>
<td>Maintain proper humidity with a modest amount of water, warn you when water is low. Keeps instruments displayed and readily available for use. Inexpensive to maintain.</td>
<td>Expensive. Single guitar cabinets generally start around $800 if using a Humidipak™ or more if using an evaporative humidifier. Multiple instrument cabinets are $4,000 and up depending on the size and features</td>
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</table>

Whatever option fits your lifestyle, instrument collection and budget, keeping your instruments properly humidified will keep them playing and sounding great, as well as protecting your investment. Ignoring humidity will almost certainly guarantee damage.