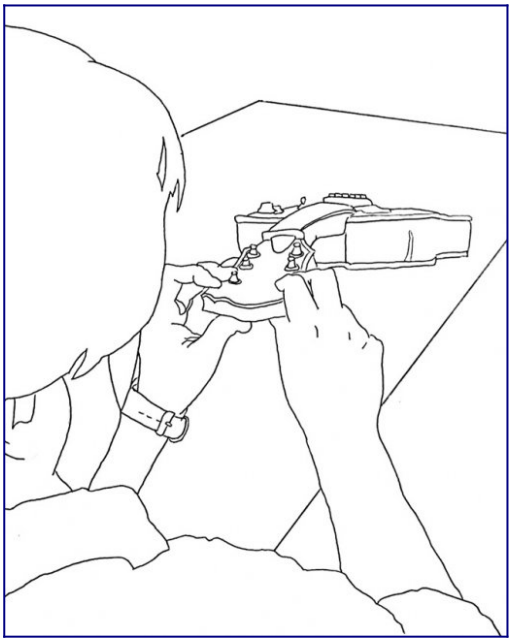
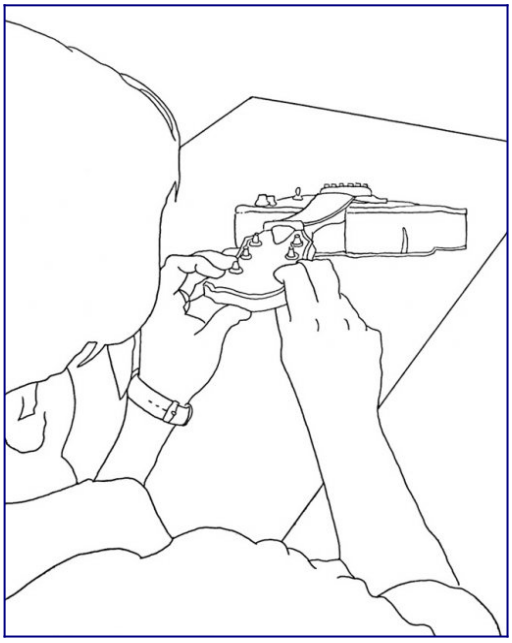
Step #1: Setting Your Neck's Relief

In simplest terms, neck relief is the amount of bow in your guitar's neck. This concept is tricky to wrap your head around without a visual aid, so here are a couple of handy diagrams to drive the point home.



E*xample of relief in a guitar neck.*



Example of backbow in a guitar neck.

And, of course, the middle point between these two extremes would be a completely straight neck. Backbow is always wrong, and a dead-straight neck is not preferable for most guitar players. Ideally, we want the slightest relief possible, with concessions for a player's style and technique. If you're trying to diagnose a relief-related issue, then a quick rule of thumb is that too little relief in a neck will often cause issues in the first five frets, while too much relief can cause problems from the ninth fret upward.

Relief is adjusted via the instrument's truss rod, the location of which can vary depending on the model. Even the slightest turn of the truss rod can make quite a difference in playability, so be gentle.

1. Tune your guitar to pitch, gently stretch out the strings, retune, and repeat the process until the strings do not shift after being stretched.
2. Place a capo on the first fret and your finger on the last fret of the low E string (for most electric guitars) or where the body joins the neck (for acoustic guitars and certain irregular electric guitar neck joints).
3. Using a feeler gauge or a digital gauge (we use the latter, as it's a much more accurate tool), measure the distance between the top of the fret and the bottom of the string at the midpoint of the string's travel. On most electrics, we take this measurement at the 10th fret. On acoustics, it will usually be at the seventh fret.
4. Consult the Sweetwater Guitar Workshop Setup Specifications Guide (pictured above) for the proper relief for your instrument/style, and then compare it to your current relief.

5. Turn the truss rod clockwise (less relief) or counterclockwise (more relief) in increments of about an eighth to a quarter of a turn.
6. Tune up, and then remeasure the relief.
7. Repeat Steps #2 through #6 until you've reached the proper relief.

Step #2: Setting Your Bridge/Saddle Action

Next, we need to take care of the saddle(s). These are located on the instrument's bridge near your picking hand and can range from individual metal pieces, like on a Fender Stratocaster, to 1-piece bridges where the saddles cannot be height adjusted without modification.

The curvature of the strings should match the curvature of the fingerboard — which is easily accomplished on adjustable saddles but not so easily adjusted on a fixed-saddle bridge. If you have a bridge with nonadjustable saddles, then they should *ideally* match the curvature of your fingerboard radius, but that's not always the case. You can check how closely they match by using this method:

1. Determine the radius of your fingerboard (the most accurate method here is by using a radius gauge, as posted measurements are not always accurate).
2. Place a capo on the first fret.
3. Slide an under-saddle radius gauge that matches your fingerboard's radius under the strings where they exit the bridge/saddle.
4. Check to see if the curvature of the strings at this point matches the curvature of the radius gauge.
5. If the radius of the strings — and therefore the radius of your nonadjustable saddle — differs from the radius of the gauge, then consult a professional tech. This is not an uncommon issue, but it does involve permanent bridge modification beyond this article's scope.

Also, you might be wondering why we keep the capo on when measuring string action, especially since almost every other technique online measures the open string from the 12th fret. The following scenario will explain why.

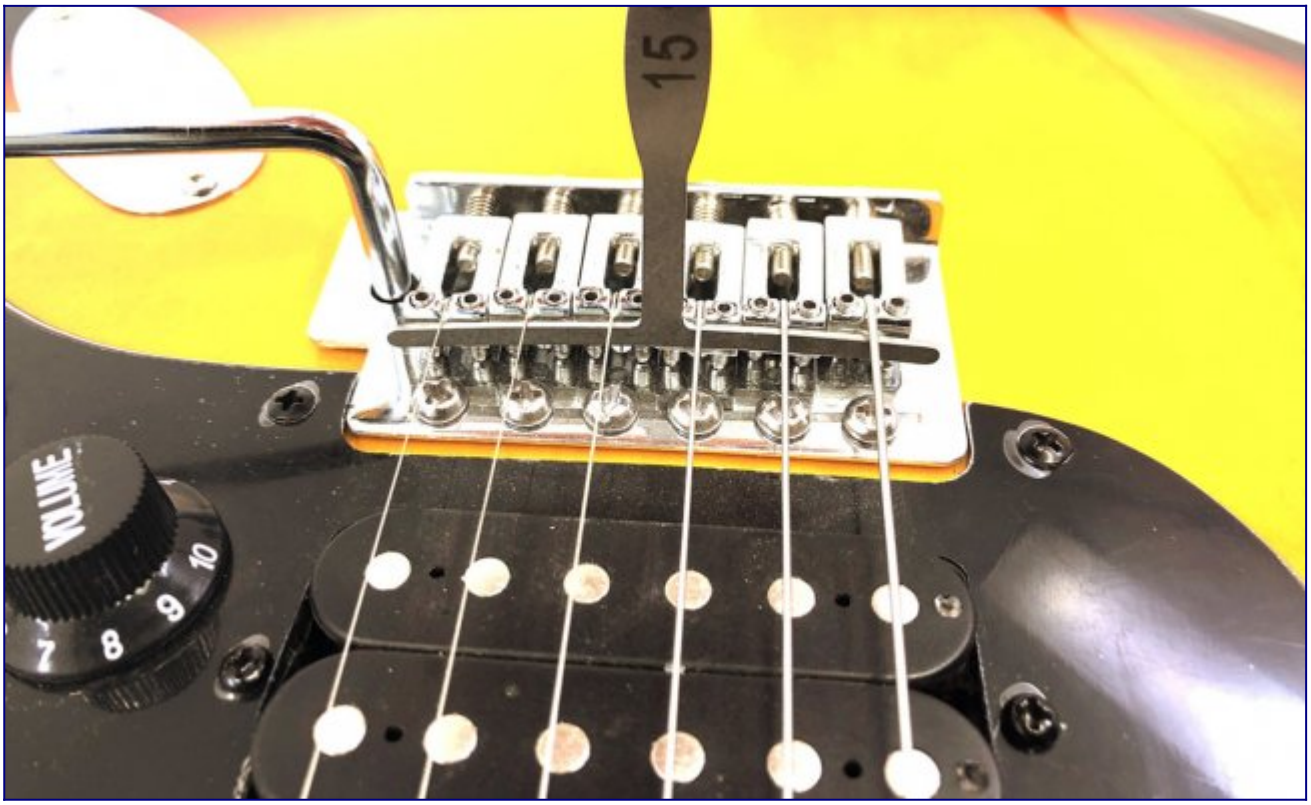
Say you've perfectly adjusted the action of all your strings, and then you decide to adjust the nut slots. If you set your action to a certain height, then file the nut slot *after* you've effectively lowered the string's overall height. Nut height will *always* impact the open action height of your instrument. So, by placing a capo on the first fret, we effectively remove the nut from the equation. When the capo is removed after properly setting the relief, saddle action, and nut action, then everything falls into place.

Adjusting Your Action

1. After properly setting your relief and with your guitar tuned to pitch, put your capo back on the first fret.
2. Adjust the two outermost saddles to the height corresponding to your preferred style on the Setup Specifications Guide. For most guitarists, this will be around 3.5/64ths to 4/64ths on the bass side and 2.5/64ths to 3/64ths on the treble side.
3. Using a radius gauge that matches your guitar's fingerboard radius (an understring gauge is preferable here), set the height of the inside four strings to match the curve of the gauge. If

performed correctly, all six strings should have a natural transition from the slightly higher action on the bass side to the slightly lower action on the treble side.

4. Test all fretted notes for clarity and comfort. Your setup is 75% done!

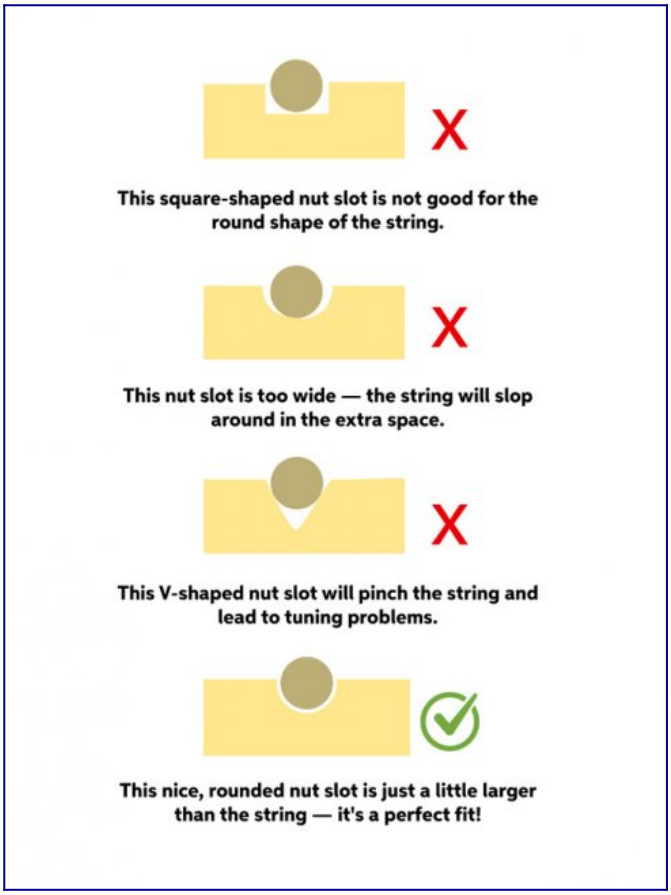


Step #3: Setting Your Nut Action

Note: While nut filing is an integral part of our setup method, it's a thoroughly advanced technique that can go wrong quickly if you're not careful. Unlike the previous steps, this one is not instantly reversible with the twist of a screw. Approach this section cautiously and be 100% certain that you're ready before taking a file to the slot.

First off, you need proper nut files — this is nonnegotiable. Plenty of at-home hack methods are proposed online to circumvent the necessity of nut files, but a hack technique may leave you with a hack result.

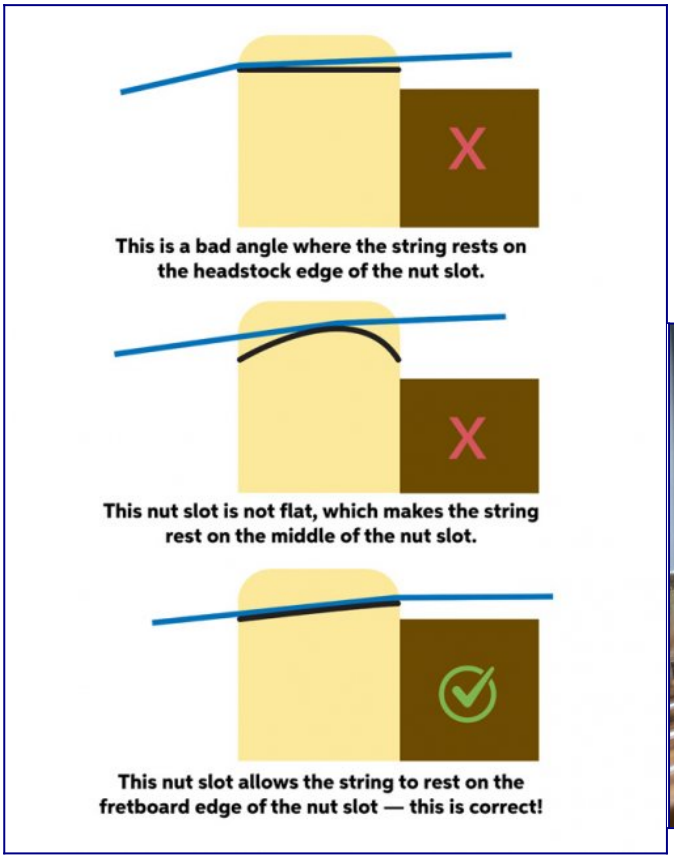
Because of the somewhat high skill floor and cost of nut files, many guitarists who otherwise perform their setups will not adjust the nut. This is a *big* mistake because the nut is crucial to the playability of your instrument in the open position, otherwise known as "the position you're probably going to be playing in the most." Saddles may adjust your overall action, but they're on the opposite end of the instrument — lowering them will not rectify a stiff-feeling string caused by high nut slots. Additionally, nut slots that are too high can negatively impact intonation in the guitar's lower register.



1. Tune your instrument to pitch.
2. Stack a couple of pieces of low tack tape directly in front of the headstock side of your nut to protect the guitar's finish from accidental file strokes.
3. Pick a string (generally, we start on either the low E or high E and then move horizontally across the fingerboard), and then measure the distance from the top of the first fret to the bottom of the string using a feeler gauge.
4. Compare the measurement to our Setup Specifications Guide.
5. If the slot is too high, then detune the string and remove it from the slot.
6. Choose the proper-sized nut file (ideally 0.002 inches greater than the string you wish to use in the slot).
7. Use a pencil to fill in the bottom of the slot with graphite. This will be a visual aid for correcting the shape and height of the slot.
8. Holding the nut file at the same angle that the string travels toward the tuning post, file in one smooth motion *toward* the headstock. You don't need to apply much pressure; let the file do most of the work.
9. As your file removes material from the nut slot, it will wear away the graphite you applied in Step #7. This reveals where your file *isn't* contacting the nut slot. The ideal nut slot is a smooth slope from the headstock end, with a sharply defined plane (known as the "takeoff point") right as the string exits the nut (demonstrated in the figure below). Reapply graphite as needed to check the shape and takeoff point of your nut slot.

10. Place the string back into the slot, bring it back up to pitch, and then remeasure to check your progress.
11. Repeat Steps #7 through #10 *very* slowly and methodically until you're near the proper height. It's very easy to over-file the slot, so if you're not yet confident in your technique, then it's better to undershoot the height than go too low. You can always remove more material; putting material back is more difficult.
12. Repeat Steps #3 through #11 for the rest of your guitar's strings.

Tip: When you get to about 0.001 inches away from your target nut action, hold off on filing for a moment. The string will often relax and drop around 0.001 inches within the next few minutes.



When filing the slot, it's vital to keep your nut file at the same angle as the string travels toward the tuning peg.

Step #4: Setting Your Pickup Height

Now, it's time to set your pickup height. When taking pickup height measurements, you first depress the string at the last fret, and then measure from the top of the pickup's pole piece to the bottom of the string.

1. While holding down the low E string at the last fret, set your bass-side pickups' height to 6/64 of an inch.
2. While holding down the high E string at the last fret, set your treble-side pickups' height to 4/64 of an inch.

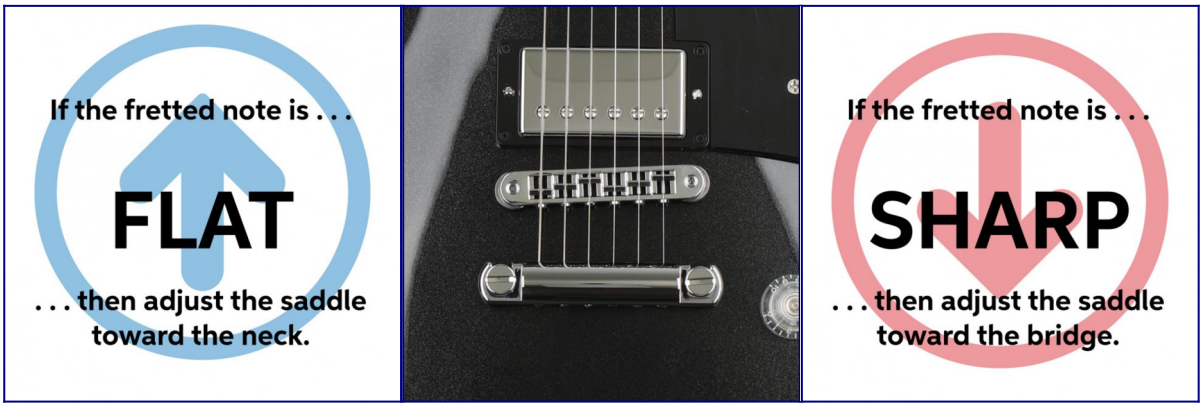
3. Play through an amp to ensure the string volumes are balanced.
4. Adjust to taste if necessary.

Pickup height highly depends on the type of pickup your guitar has and your personal taste; our measurements are simply a good starting point.

Step #5: Setting Your Intonation

Intonation is the very last step of the setup and is easy if you have a high-quality strobe tuner. What is intonation? You may have noticed that certain strings on certain frets sound more in tune than others. Intonation is how “in tune” each note is, and it’s always a compromise on traditional fretted instruments.

By adjusting the saddles so that the 12th fret note (the midway point of your guitar’s scale length) is as close to “in tune” as possible, an acceptable intonation compromise across the rest of the instrument’s register is achieved.



1. Pick a string (generally, we start on either the low E or high E and then move horizontally across the fingerboard).
2. Play the 12th fret harmonic and ensure that the note is as in tune as possible with your tuner.
3. Fret the string at the 12th fret, and then use your tuner to gauge how sharp or flat the note is. The *attack* of the note is what you’re measuring here; the note may fluctuate as it trails off.
4. Choose the appropriate screwdriver/hex key/etc. tool to adjust your guitar’s respective bridge/saddle system.
5. If the note is flat, then bring the saddle *toward* the headstock end to decrease the overall length of the string.
6. If the note is sharp, then push the saddle *away* from the headstock end to increase the overall length of the string.
7. Retune the string. Double-check that the 12th fret harmonic is accurate.
8. Repeat Steps #2 through #7 until the note played at the 12th fret is as close to the open harmonic as possible.
9. Repeat Steps #1 through #7 for all the other strings.

How Do I Get Rid of this Annoying Buzz?

A: It can be vexingly difficult to diagnose string buzz. Here's a list of ten possible causes that I look for. If this checklist doesn't identify the problem, I sometimes resort to offering sacrifices to the guitar gods.

1. Low Nut Slot
This typically causes problems on the open note, but can sometimes create buzzing between the nut and a fretted note. If you suspect the latter, play the fretted note and then damp the string between the nut and the fret while the note is still ringing. If the buzz goes away you may need a new nut or "nut implant."

2. Improperly Shaped Nut Slot
A string that bears too heavily on the middle or the back of the nut slot can buzz in a sitar-like way on the front of the slot. This can be corrected with a couple well-directed strokes of a nut file.

3. Improper Saddle Contact
Same issue as above, only at the saddle. This occurs most often on taller saddles having acute string-break angles.

4. Bad Strings
Buzzing can sometimes result from windings that have come loose from their core. I have even seen new, obviously defective strings with this problem.

5. Touching Strings
No two strings should touch in the area around the tuner posts. Custom nut spacing, replacement tuners, and oddball string gauges are the usual culprits.

6. Bouncing Frets
An improperly seated fret can elude accurate leveling, then bounce back up and continue causing buzzing problems. Superglue and a little spot dressing can get you to your next full fret replacement.

7. Neck Too Straight
The physics of string oscillation dictates that fretboards should rarely be straight and never bowed backward. Ideal fretboard shape depends on scale length, string gauge, playing style, and other factors. A good tech can optimize your guitar for your style and playing preferences, but cannot change the laws of physics. Sometimes you just need more relief.

8. Loose Joint
A loose brace, bridge, binding joint, nut, or any ill-fitting part can cause vibration sympathetic to a specific note. I hunt for loose joints by damping strings and tapping around the entire guitar. The fix is often easier than the diagnosis.

9. Loose Pickup
This sympathetic vibration merits a category of its own. The problem is often a loose cable which can be detected by damping the strings and shaking the guitar. Recently, I found buzzing related to a loose jack cover.

10. Sympathetic Truss Rod
Think of the truss rod as a big guitar string that can be tuned to a note that's either sympathetic or not sympathetic to a significant resonant frequency. You get the picture.

I play a Martin D-28SW. I have been using medium-gauge Martin Monel Tony Rice strings for several years and like them a lot. Some of the strings, particularly the wound third, get a little stuck when I am tuning. If the string is a little sharp and I tune it down, the pitch drops too far. When I tune back up, the string goes too sharp, with a little clicking sound. How can this slight but annoying tuning problem be fixed? —Bill Pramuk, Napa, CA

A: What you're experiencing is a very common problem—and, happily, one that's easily remedied.

It relates to the size and shape of the slots in the nut, which is a critical area where a few thousandths of an inch can make a big difference in your comfort, intonation, and tuning stability.

The click you hear is the sound of string tension being released from one side of the nut to the other. This is quite possibly due to the larger gauge of the Monel strings you mentioned, which at .013–.056 are heavier than the .012–.052 set Martin likely installed on the guitar during assembly. Thicker strings will require the nut slots to be widened, ensuring that they can pass freely through the slots without any binding or pinching. Because of the break angle (the angle change between the fretboard and the headpiece) there will always be some downward pressure from the string, so it's important that the slot be shaped and finished correctly, as well as sized appropriately.

When correctly cut, a nut slot should have a U-shaped profile—straight walls and a half-rounded bottom. A common problem is slots with a V shape—in these cases, downward pressure causes the string to wedge itself into the narrowing bottom of the V, and inevitably the string will pinch and bind as a result. The slot bottom should be smooth and free of "chatter marks," the rough texture caused by incorrect or incomplete filing. I usually size nut slots anywhere from .003–.006 inches larger than the stated string diameter. This avoids any potential friction, even in cases where the player goes up a gauge.

Nut-slot depth is the other parameter that has a big impact. If the slots are filed too deeply, the open strings will buzz and the nut will require replacement or repair. However, the much more common scenario is that the slots are shallow—in this case, the strings will be too far above the frets. As a result, simply pressing the strings to the frets will bend them sharp. This effect will be most noticeable in the first few positions—and since that is where one usually includes open strings alongside fretted ones, it is usually very noticeable. During setup, most luthiers use feeler gauges or other measuring tools to dial in a nut depth that allows minimal clearance above the frets without buzzing. Different players and playing styles sometimes require specific tweaks—if you're an open-position strummer, your ideal setup may well be different from that of a fleet-fingered soloist.

This would be a good moment to mention the wide range of nut materials that are available. Traditionally, nuts and saddles were made of organic bone, which is plentiful, durable, easily worked with hand tools, and can be polished to an attractive finished surface. Some vintage instruments even have ivory nuts—thankfully, that is no longer done! Bone remains the standard against which other materials are evaluated, and there is a widespread belief that it is still the best choice for tone.

However, many other more modern materials have proven themselves as viable alternatives. In the 1970s, brass nuts were very popular, and a well-cut brass nut can perform quite well. (Frets themselves are made of a brass alloy, after all.) Synthetics such as Corian, Delrin, carbon fiber/graphite, and other

composites are increasingly used in both production guitars and handmade instruments, and they offer some compelling advantages compared to the old standard: they are easier to machine without chipping or cracking and can in some cases be molded to very close tolerances, allowing for quicker and more accurate setups in a factory setting. Some nut materials also incorporate graphite and other self-lubricating materials, which help alleviate pinching and binding issues.

Finally, composite materials are much more uniform and homogenous—bone, as a natural material, varies quite widely in strength, density, and resilience, and not all pieces are guaranteed to make good nuts. For these reasons, many manufacturers have gone over to composites for these parts, with excellent results—factory setups on acoustic guitars have steadily improved in the last 15–20 years, which is great news for players at every level.

There is considerable debate among players about the effects of nut material on tone. The loudest voices in these discussions are usually those advocating for bone, and it's quite true that the classic American flattop tone includes bone nuts and saddles, however large their contribution may be. But there are countless factors that affect the tone of any given instrument, and many of them are much more significant: the properties of the top, back and side material, size and position of the bracing, stiffness of the neck, and many more. Next to these fundamental properties, nut and saddle material make, in my experience, a relatively small impact—and in the case of the nut, an impact that is only heard when playing open strings. A great guitar will be great regardless of the nut material, and a poor one usually can't be saved by a magic piece of bone.

Ultimately, the nut setup is far more important than the material—a poorly adjusted nut will make a guitar difficult to play, hard to keep in tune, and impossible to intonate—and that will be far more noticeable than any little tone difference I can imagine!

A qualified luthier should be able to fine-tune the nut for your strings in relatively little time, and you will likely notice benefits to your action and intonation, as well as your tuning stability. These adjustments have possibly the most bang-for-your-buck of any investment you can make in your setup, and they will pay off every time you pick up the guitar.

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